SCHEME OF STUDY FOR TWO-YEAR ASSOCIATE DEGRE AND BS (4-YEAR) PROGRAM

(Effective for the student admitted in Botany Department, University of Lakki Marwat in Fall 2022, and affiliated colleges with University of Lakki Marwat)

DEPARTMENT OF BOTANY
UNIVERSITY OF LAKKI MARWAT

FIRST YEAR (SEMESTER FIRST)

Course Code	Pre-Requisite	Course Title	Credit Hrs	Total Credit Hrs
EW-		English composition and comprehension (Eng-I)	03	18
AH-		Islamic History& Culture	03	
NS-		Everyday Science	03	
		ICT Fundamentals of Computer Programing	03	
SS-		Introduction to Sociology	03	
QR-		Introduction to Statistics	03	

FIRST YEAR (SEMESTER SECOND)

Course Code	Pre-Requisite	Course Title	Credit Hrs	Total Credit Hrs
EW-		Communication and presentation skills (Eng-II)	03	18
AH-		History of Pakistan	03	
NS-		Introduction to Botany	03	
CIV-		Islamic Studies	03	
SS-		Human Psychology	03	
QR-		Basic Mathematics	03	

SECOND YEAR (THIRD SEMESTER)

Course Code	Pre-Requisite	Course Title	Credit Hrs	Total Credit Hrs
EW-		Technical report writing (Eng-III)	03	18
CIV-		Pakistan Study	03	
BOT-110	Foundation-I	Diversity of Plants	04 (3+1)	
BOT-111	Foundation-II	Plant Systematics, Anatomy and Development/ Embryology	04 (3+1)	
BOT-112	Foundation-III	Cell Biology, Genetics and Evolution	04 (3+1)	

SECOND YEAR (SEMESTER FOURTH)

Course Code	Pre-Requisite	Course Title	Credit Hrs	Total Credit Hrs
BOT-120	Foundation-IV	Plant Physiology and Ecology	04 (3+1)	17
BOT-121	Foundation-V	Biodiversity and Conservation	04 (3+1)	
BOT-122		Biostatistics	03 (2+1)	
BOT-123	Foundation-VI	Bacteriology and Virology	03 (2+1)	
BOT-124	Major-I	Phycology and Bryology	03 (2+1)	

THIRD YEAR (FIFTH SEMESTER)

Course	Pre-Requisite	Course Title	Credit Hrs	Total Credit Hrs
BOT-210	Major-II	Mycology and Plant Pathology	03 (2+1)	15
BOT-211	Foundation-VII	Diversity of Vascular Plants	03 (2+1)	
BOT-212	Major-III	Plant Systematics	03 (2+1)	
BOT-213	Foundation-VIII	Plant Anatomy	03 (2+1)	
BOT-214	Major-IV	Genetics-I	03 (2+1)	

THIRD YEAR (SIXTH SEMESTER)

Course	Pre-Requisite	Course Title	Credit Hrs	Total Credit Hrs
BOT-220	Major-V	Plant Biochemistry-I	03 (2+1)	15
BOT-221	Foundation-IX	Plant Ecology-I	03 (2+1)	
BOT-222	Major-VI	Plant Physiology-I	03 (2+1)	
BOT-223	Major-VII	Molecular Biology	03 (2+1)	
BOT-224	MAJOR-VII	Phytogeography	03 (2+1)	

FOURTH YEAR (SEVEN SEMESTER)

Course	Pre-Requisite	Course Title	Credit Hrs	Total Credit Hrs
BOT-310	Major-VIII	Plant Biochemistry-II	03 (2+1)	15
BOT-311	Major-IX	Plant Ecology-II	03 (2+1)	
BOT-312	MAJOR-X	Research Methodology	03 (2+1)	
BOT-313		Elective-iii/Research Project / Internship/Optional paper (Optional paper: Medicinal Plants (Pharmacognosy)	03 (2+1)	
BOT-314		ELECTIVE-II (Plant pathology)		

FOURTH YEAR (EIGHT SEMESTER)

Course	Pre-Requisite	Course Title	Credit Hrs	Total Credit Hrs
BOT-320	Major-X	Plant Physiology-II	03 (2+1)	15
BOT-321	Major-XI	Genetics-II	03 (2+1)	
BOT-322	Major-XI	Environmental Biology	03 (2+1)	
BOT-324		Elective-iii/Research Project / Internship/Optional paper Optional paper: Wetland ecology	03 (2+1)	
BOT-325		ELECTIVE-IV (Forestry and Agroecology)	03 (2+1)	

GRAND TOTAL: 131 CR. HRS

COURSES FOR BRIDGING SEMESTER

Course Code	Course Name	Cr.Hr	Total Credit Hrs
BOT-110	Diversity of Plants	03	18
BOT-111	Plant Systematics, Anatomy and Development/ Embryology	03	
BOT-112	Cell Biology, Genetic and evolution	03	
BOT-120	Plant Physiology and Ecology	03	
BOT-121	Biodiversity and Conservation	03	
BOT-123	Bacteriology and Virology	03	

DETAILS OF COURSE CONTENT

FIRST YEAR
FIRST SEMESTER

Course Code	Pre-Requisite	Course Title	Credit Hrs
EW-		English composition and comprehension (Eng-I)	03

Course Description:

The course is designed to help students take a deep approach in reading and writing academic texts which involve effective learning strategies and techniques aimed at improving the desired skills. The course consists of two major parts: the 'reading section' focuses on recognizing a topic sentence, skimming, scanning, use of cohesive devices, identifying facts and opinions, guess meanings of unfamiliar words. The 'writing section' deals with the knowledge and use of various grammatical components such as, parts of speech, tenses, voice, narration, modals etc. in practical contexts.

Course Contents

1. **Reading Skills**

- Identifying Main Idea / Topic sentences
- Types of Reading Skills: skimming, scanning, extensive and intensive
- Active and Passive Reading
- Strategies for Improving Reading Skills
- Finding Specific and General Information Quickly
- Distinguishing Between Relevant and Irrelevant Information According to Purpose for Reading
- Recognizing and Interpreting Cohesive Devices
- Distinguishing Between Fact and Opinion
- Reading Comprehension

2. Writing Skills

- Sentence patterns and structures
- Phrase, clause
- Parts of Speech
- Tenses: meaning and use
- Modals
- Use of active and passive voice
- Reported Speech
- Writing good sentences
- Error Free writing
- Paragraph writing with topic sentence

Recommended Readings

- Howe, D. H, Kirkpatrick, T. A., & Kirkpatrick, D. L. (2004). *Oxford English for undergraduates*. Karachi: Oxford University Press.
- Eastwood, J. (2004). *English Practice Grammar* (New edition with

tests and answers). Karachi: Oxford University Press.
- Murphy, R. (2003). *Grammar in use.* Cambridge: Cambridge University Press.

Course Code	Pre-Requisite	Course Title	Credit Hrs
AH-		Islamic History& Culture	03

Objectives:

This course is aimed at:

- To provide basic information about Islamic History
- To provide basic information to the students about the life of the Holy Prophet Hazrat Muhammad (S.A.W).
- To inform the students about the administrative system of Califat e Rashida period.
- To inform the students about the rule and administrative system of Umayyad period, Abbasids period and Muslims in Spain.
- To enhance understanding of the students regarding Islamic Culture and Civilization.
- To enhance skills of the students for understanding of issues related to faith and religious life.
- To communicate historical knowledge effectively and pursue higher studies in History and related fields.

Course Contents:

Part. 1 Life of the Holy Prophet Hazrat Muhammad (S.A.W)

1. Land and Geography of Arabia
2. Conditions of Arabia at the advent of Islam
3. Makki Life of the Holy Prophet (S.A.W)

   3.1 Parentage, Birth and Early Childhood

   3.2 Harb ul Fujjar, Half fu Fazool, Nikah and Re-Construction of Kaba

   3.3 Baasat e Nabvi, Preeching of Islam and Hostility of Quraish

   3.4 Emigration to Abyssinia 1st and 2nd , Aam ul Huzn, Pledge of Aqba 1st and 2nd

   3.5 Hijrat e Madina
4. Madni Life of the Holy Prophet (S.A.W)

   4.1 Causes, Events and Importance of Hijrat e Madina

4.2 Charter of Madina

4.3 Gazwat e Nabvi, Treaty of Hudaibiya and Conquest of Makkah

5. Last Sermon of the Holy Prophet (S.A.W)
6. Seerat tu Nabi (S.A.W)

Part. 2 Rashidun' Period

1. Hazrat Abu Bakr Saddiq (R. A)
2. Hazrat Umar Farooq (R. A)
3. Hazrat Usman (R. A)
4. Hazrat Ali (R. A)
5. Administration system and main Features of Rashidun Period

Part. 3 Umayyads' Period

1. Hazrat Amir Mu'awiya (R. A)
2. Yazed and Karbala incident
3. Hazrat Abdullah bin Zubair (R. A)
4. Marwan and Abdul Malik bin Marwan
5. Walid bin Abdul Malik and Sulaiman bin Abdul Malik
6. Hazrat Umar bin Abdul Aziz (R. A)
7. Later Rulers of Umayyad Dynasty
8. Administration under Umayyads and causes of their downfall

Part. 4 Abbasids' Period

1. As-Safah and Abu Jafr Al-Mansoor
2. Hadi, Mahdi, Haroon ur Rashid
3. Amin, Mamoon and Moatasim
4. Later Rulers of Abbasids' Dynasty
5. Administration under Abbasids and causes of their downfall
6. Crusades and Sultan Salah ud Din Ayubi
7. Muslims in Spain
8. Administration and Causes of the downfall of Muslims in Spain

Recommended Books:

- Islamic History (P-I and P-II). Published by KP Textbook Board Peshawar.
- Dr. Hameed du Din. “Tareekh e Islam”.
- Mazar ul Haq. “History of the Arabs”.
- Shah Moeen ud Din. “Tareek e Islam”.
- تاریخ الخلفاء (اردوترجمہ)------علامہ جلال الدین سیوطی
- خلافت اندلس ---------نواب ذوالقدر جنگ
- تاریخ اندلس --------مولانا ریاست علی ندوی
- تاریخ اسلام ----------اکبر شاہ خان نجیب آبادی
- تاریخ الامم والملوک (اردوترجمہ)----ابن جریر طبری

Course Code	Pre-Requisite	Course Title	Credit Hrs
NS-		Everyday Science	03

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

1. To develop inquiring minds and curiosity about science and the natural world.
2. To acquire knowledge, conceptual understanding and skills to solve problems and make informed decisions in scientific and other contexts.

COURSE OUTLINE:

0 **Science,**

1 Introduction, History of Science, Achievements of some giants of Science in Chronological order, Islamic Science, Contribution of Muslim Scientists, Famous muslim scientist, Nature of science, Scientific method, impact of science on society.

0 **The Universe,**

2 Introduction, The origin, The Big Bang, The structure, the galaxies, solar system, The sun, the moon, the earth,structure of the earth, earth atmospheres, the green house effect, global warming, ozone depletion, acid rain, stattelites, earthquake, eclipses, the mystery of Stonehenge, day-night and seasons, volcanoes, minerals, glossary of cosmology

0 **Energy,**

3 Introduction and sources of energy, Fossil Fuels, Major oil producing countries, Global search of Crude oil, Petroleum products, natural gas, hydel power or hydro-electric power, solar energy, nuclear energy, the nuclear reactor, heavy water, nuclear safety, nuclear fusion, energy coversion, radiation and living things.

0 **Products of science,**

4 Ceramics, Semi-conductors, Communications systems, Laser, Telescope,

Camera, Fertilizers, Nanotechnology, Plastics, Computer

0 **Living Creature:**

5 Brain, Heart, Tissues, Epithelial Cell, Origin of Modern Humans, Pest

Control, Protein, Vertebrate, Invertebrate, Liver, Enzymes, Organisms

(Common to all living things), Blood Group system. Plants, Seed, Flower,

Gene, Evolution Laws, Nucleic Acid (DNA and RNA)

0 **Diseases and Threats to Living organism:**

6 Swine flow, Hepatitis, Dengue fever, Corona virus, SARS (Severe acute respiratory syndrome virus), Plants and Crop Diseases (Rust, Smut, Late

Blight, Canker),

- Physiology)

Text book:

[1]. Prof. Dr. Akram Kashmiri (Third edition, A. H. Publisher) [2].

Everyday science by Dr. Riaz ul haq

Reference Book(s)

[1]. Exploring physical science 1977 by walter A. Thurber

[2]. Exploring Life science 1975 by walter A. Thurber

[3]. Encyclopedic Manual of everyday science, Author, Dr. Rabnawaz Samo Publisher; Maktab e Faridi.

Course Code	Pre-Requisite	Course Title	Credit Hrs
		ICT Fundamentals of Computer Programing	03

Course Contents

Basic definitions and concepts, Brief history of computers and their applications, Hardware: Computer Systems and components, Primary and secondary storage, Input and Output devices, Software: System Software and Application Software, Various categories of application software and their usage, programming languages.

Data base, Database system and its types. Data communication and networking, internet and world wide web, Internet searching techniques, E-learning, Introduction to Freelancing.

Reference Material:

- Introduction to Computer by Peter Norton.
- Fundamental of Electronic data processing By S.Jaiswal
- Using Information Technology by Brian K. Williams.

Course Code	Pre-Requisite	Course Title	Credit Hrs
QR-		Introduction to Sociology	03

Course Contents:

Fundamental of Sociology

1.1 Nature, Scope, and subject matter of Sociology
1.2 Brief historical development of Sociology
1.3 Society and community
1.4 Relationship with other social sciences like Economic, Political Science, History, Psychology, and Anthropology.
1.5 Social interaction processes (Cooperation, Competition, Conflict, Accommodation, Acculturation, and Assimilation).

Social Groups

2.1 Definition and Functions
2.2 Types of Social Groups (In and out group, Primary and Secondary groups, Reference groups. Formal and informal Groups and Pressure groups)

Social Institutions

3.1 Definition, Structure and Function of the following Institutions: Family, Religion, Education, Economics, Political Inter-relationship among various social institutions.

Cultural and Related Concepts

4.1 Definition and aspects of culture, Material and non-material culture, Ideal and real culture
4.2 Elements of culture, Beliefs, values, norms (folkways, mores, laws)
4.3 Organization of culture, Traits, complexes, and patterns
4.4 other related concepts, Cultural relativism, Sub-Culture and ethnocentrism

Socialization and Personality

5.1 Role and Status
5.2 Socialization
5.3 Culture and Personality

Deviance and Social Control
6.1 Definition and types of deviance
6.2 Formal and informal methods of social control
Social Stratification
7.1 Determinants of Social Stratification (Caste, Class, Ethnicity, Power, Prestige and Authority)
7.2 Social Mobility, Definition and types
7.3 Dynamics of social mobility
Social and Cultural Change
8.1 Definition of social change
8.2 Dynamics of social change (Education, Innovation, Industrialization, Urbanization and Diffusion)
8.3 Resistance to change

Suggested Readings/books.

1. Horton Paul B. and Hunt, Chester L (1990), Sociology Singapore: McGraw Hill Book Company.
2. Sociology 1 by Allama Iqbal Open University, Islamabad iii. Sociology 2 by Allama Iqbal Open University, Islamabad
3. Taga, Abdul Hameed (2000) An Introduction. New York: Harper and Rows
4. Betrnad, Alvin L. (1969). Basic Sociology-An Introduction to Theory and Methods, New York; Appleton Century Crofts.
5. Curran, Jr.(1977).Introductory sociology: A basis Self Instructional Guide
6. Hafeez, Sabeeha (1990), The Changing Pakistan Society. Karachi: Royal Book company, Zaibunisa Street, Sadar.
7. Horton Paul B. and Hunt, Chester I.. (1990) Sociology singapore.Macgraw Hill Book Company.
8. Merrii, F.E., (latest ed,), Sociology and Culture. N.J. Englewood Cliffs.
9. Philips, Bernard (1990). Sociology-Form Concepts to Practice. New York: McGraw Hill Book Company Inc.
10. *Rao, C. Nshaukar (1990), Sociology, New Delhi: S.C Chand and Company Ltd.*

Course Code	Pre-Requisite	Course Title	Credit Hrs
QR-		Introduction to Statistics	03

Will upload soon

FIRST YEAR
SECOND SEMESTER

Course Code	Pre-Requisite	Course Title	Credit Hrs
EW-		Communication and presentation skills (Eng-II)	03

Course Description:

The course focuses on the basic strategies of composition and writing skills. Good writing skills not only help students obtain good grades but also optimize their chances to excel in professional life. The course includes modes of collecting information, arranging it in appropriate manner such as chronological order, cause and effect, compare, and contrast, general to specific etc. It enables the students to write, edit, rewrite, redraft and proofread their own document for writing effective compositions. Because of the use of a significant amount of written communication on daily basis, sharp writing skills have always been valued highly in academic as well as professional spheres.

Course Contents:

1. Writing Process
   - Invention
     - ✓ Generating Ideas (collecting information in various forms such as mind maps, tables, lists, charts etc)
     - ✓ Identifying Audience, Purpose, and Message
   - Ordering Information
     - ✓ Chronology for a narrative
     - ✓ Stages of a process
     - ✓ From general to specific and vice versa
     - ✓ From most important to least important
     - ✓ Advantages and disadvantages
     - ✓ Comparison and contrast
     - ✓ Problem solution pattern
   - Drafting
     - ✓ Free Writing
     - ✓ Revising
     - ✓ Editing
2. Paraphrasing
3. Cohesion and Coherence
   - Cohesive Devices
   - Paragraph unity
4. Summary and Precis Writing
5. Creative Writing
6. Essay Writing
   - developing a thesis

- organizing an essay
- writing effective introduction and conclusion
- different types of essays
- use of various rhetorical modes including exposition, argumentation and analysis

Recommended Books:

- Goatly, A. (2000). *Critical Reading and Writing: An Introductory Course*. London: Taylor & Francis
- Hacker, D. (1992). *A Writer's Reference*. 2nd ed. Boston: St. Martin's
- Hamp-Lyons, L. & Heasley, B. (1987). *Study writing: A course in written English for academic and professional purposes*. Cambridge: Cambridge University Press.
- Howe, D. H, Kirkpatrick, T. A., & Kirkpatrick, D. L. (2004). *Oxford English for Undergraduates.* Karachi: Oxford University Press.

Course Code	Pre-Requisite	Course Title	Credit Hrs
AH-		History of Pakistan	03

Will upload soon

Course Code	Pre-Requisite	Course Title	Credit Hrs
NS-		Introduction to Botany	03

Specific Objectives of course:

To disseminate the basic concept of plants and their characteristic features

Course Outline:

Comparative study of life form, structure, reproduction and economic significance of plants.

Introduction: Origin of plants, historical background of Botany and sub branches of Botany

1. The Plant Cell

a. Chemical Composition
b. Cell Structures
c. Metabolism in Cells, including Photosynthesis

2. Plant form and function

a. Plant tissues
b. Plant Organs: Roots, Stems and Leaves
c. Flowers, Fruits and Seeds
d. Mineral, Nutrient and Water Transport in Plants
e. Plants nutrition and Soils
f. Plant defense response
g. Sensory system in plants

4. The Continuity of Plant Life

a. The Molecular Basis of Inheritance
b. Evolution of plants Populations and Species

5. Diversity of Plants

a) Angiosperm and gymnosperm
b) Monocot and dicot
c) Cryptogams and phanerogams
d) Xerophytes and Halophytes (with special reference of mangrove forests)
e) Vascular and nonvascular plants
f) Human Uses of Plants in Agriculture, Commerce, Medicine and Ecology

6. Plant Ecology

a. Ecosystems
b. Biomes of the World

7. Dendrochronology: The science of tree-ring and its application

Recommended Books

1. Lindley, John. An introduction to botany. Longman, Orme, Brown, Green, and Longmans, 1839.
2. Mauseth, J. D. (2014). Botany: an introduction to plant biology. Jones & Bartlett Publishers.
3. Mason, KA., Losos, JB., Singer, SR. (2017). Biology, Eleventh Edition . MC Graw Hill Education
4. Chaffey, N. (2014). Raven biology of plants. Annals of botany, 113(7), vii.
5. Ahmed, M. M. 2009. An introduction to dendrochronology. Urdu University press.
6. Urry, L. A., Cain, M. L., Wasserman, S. A., Minorsky, P. V., & Reece, J. B. (2017). Campbell biology. Pearson Education, Incorporated.

Course Code	Pre-Requisite	Course Title	Credit Hrs
CIV-		Islamic Studies	03

Objectives:

This course is aimed at:

- To provide basic information about fundamental beliefs and Pillars of Islam
- To enhance understanding of the students regarding Quran and Sunnah
- To inform the students about the practical life of Prophet Muhammad (SAW)
- To provide the students with the sufficient knowledge about economic, social and cultural systems of Islam
- To boost up the balanced, enlightened and broad minded information of Islam in students
- To enable the students for adopting Islamic ethics and moral values
- To enable the students to live peacefully in a pluralistic and diversified society
- To promote the feelings of human sympathy in students without the condition of race or religion

Course Contents

1. Study of Fundamental Religious Beliefs & Practices

1.1 Islamic Beliefs:

i. Importance of Beliefs in personality building (general discussion)
ii. Study of the Islamic Beliefs: (Beliefs in Almighty Allah, Angles, Revealed Books, Prophet hood as well as Finality of Prophet hood, Destiny, Day of Judgment (Resurrection), desired effects of Islamic beliefs on Individual and Society

1.2 Practices (Ibadaat) of Islam

Philosophical Study of *Ibadaat*:

i. Definition and Scope of *Ibadah*
ii. Physical Submissions i.e. prayer and fasting : its rationale and its desired effects on Individual and society
iii. Financial Submissions i.e. Zakat and alms giving: its rationale and its desired effects on Individual and society
iv. Collective Submissions [Physical cum Financial] i.e. performing Hajj and Umarh: its rationale and its desired effects on Individual and society
v. Scope of chain of various *Ibadah*

2. Study of Basic Sources of Religion

2.1 Study of Quran:

i. Sources of Knowledge
ii. Need for Revelation
iii. Division of Surahs in Makki and Madani Titles
iv. Brief introduction of various kinds of Ayaa (verses) i.e. Ayaat ul Ahkaam, Ayaat Anfusi, Ayaat Kawnia.
v. Special focus on the behavior of Qura'n with other divine books and prophets in the lights of Qura'nic texts
vi. Textual & Thematic Study of Holy Quran:
    a. Surah Hujarat (Complete) with special focus on ethics and morality
    b. Surah Israa verses 23-40 with special focus on ethics and morality

2.2 Study of Sunnah:

i. Meaning of Hadith & Sunnah and its kinds (Qawli, Feli, Taqreeri)
ii. Need, Importance of Hadith and its authority
iii. Important Books of Hadith (*Sihah Sitta* and *Kutub-e-Arbah*)
iv. Textual & Thematic Study of Hadith: Study of 20 Selected Hadiths (attached as Annex-1)

3. Brief Study of Biography of Prophet Muhammad (SAW)

3.1 Year wise Summary of Prophet's Life

3.2 Lessons learnt from life at Makkah

3.3 Lessons learnt from His life at Madinah with special reference to pact of Madina and Hudaibiyyah

3.4 *Hijrat* (Migration): its philosophy in general, causes and results

3.5 Jihad: Definition, Philosophy, justification (with special reference to *Badr*, *Uhad* and *Khandaq*)

4. Study of Islam in Multi-dimensional Aspects

4.1 Cultural and Social System of Islam**:** Introduction of Society and Culture, Salient features of Islamic culture and Society

4.2 Economic System of Islam: Basic concepts of Islamic economic system, Means of distribution of wealth in Islam

4.3 Political System of Islam: Basic concepts of Islamic political system, Qualities of Islamic political System

5. Pluralism, Diversity and Islam

5.1 Introduction of Pluralism and diversity, with special reference to diversity in Universe

5.2 Diversity in humans (personalities, gender, interests, hobbies, languages etc.)

5.3 Religious diversity, with special focus on various religions and sects

6. Human Rights and Islam

6.1 Concept and significance

6.2 Human Rights in Islam

6.3 Human Rights in the constitution of Pakistan

6.4 Human Rights in UNO Charter

7. Peace Education and Conflict Resolution

7.1 Peace: Concept, its significance in personal, domestic, social, national and International level

7.2 Religious instructions regarding peace in various dimensions of life

7.3 Conflict: Reasons and Stages of conflict, Reconciliation

7.4 Role of Communication in Peace building: Concept of Communication, Effective Communication, Rehabilitation of peace through communication

7.5 The role of inter and intra faith dialogue in maintaining peace as well as religious Harmony on national and international level

Recommended Books

1. Hamidullah, Dr. (2000), *Introduction to Islam*, Dawah Academy, Islamabad

2. Khan, Rafique Ali(2001), *Freedom of Thought in Islam*, Royal Book Company, Karachi
3. Ali, Syed Amir (2009), *The Spirit of Islam*, Islamic Book Service, Lahore
4. Hamidullah, Dr. (2005), *Muhammad Rasulullah: A concise survey of the life and work of the founder of Islam*, Dawah Academy, Islamabad
5. Hamidullah, Dr. (2000), *Islamic Notion of conflict of Laws*, Dawah Academy, Islamabad
6. UNO Charter of International Human Rights of 1948

7. مودودی، سید ابو الاعلیٰ(2002)، انسان کے بنیادی حقوق، اسلامک پبلی کیشنز ، لاہور
8. قطب، سید محمد(2010)، اسلام اور جدید ذہن کے شبہات، ہولی قرآن پبلی کیشنگ ہاؤس، کراچی
9. صدیقی، حیدرزمان(2006)، اسلامی نظریہ اجتماع، یونیورسل بکس، لاہور
10. اصلاحی، صدرالدین(2011) اسلام اور اجتماعیت، اسلامک پبلی کیشنز، لاہور
11. زیدان، عبدالکریم(2002)، اسلام میں ریاست اور فرد کا مقام، ادارہ ترجمان القرآن ،لاہور
12. پاکستان کمیشن برائے انسانی حقوق (2012)، پاکستان میں انسانی حقوق کی صورت حال، میڈیا سیل پاکستان کمیشن برائے انسانی حقوق، لاہور
13. نعمانی، محمد شبلی (2003)، سیرت النبی ، مکتبہ رحمانیہ اردو بازار، لاہور
14. الازہری، پیر کرم علی شاہ(2010)، ضیاء النبی، ضیاء القرآن پبلی کیشنز، لاہور

Course Code	Pre-Requisite	Course Title	Credit Hrs
SS-		Human Psychology	03

Course Objectives

- The main aim is to familiarize students with history, main concepts, methods, and theoretical frameworks in psychology.
- The course will help students appreciate the human nature and its related concepts, thereby will gain insight into human behavior and human relationships.

Course Outcome

After successful completion of this course the students will be able to:

- Have a grasp over basic concepts and theoretical perspectives explaining human behavior. They will be able to appreciate the complexity of human behavior and relationships.
- They will be able to understand Psychology as science and empirical methods used for understanding different aspects of human behavior.

Course Contents

Understanding Psychology

Psychology: Scientific perspective
Historical perspective
Schools of psychology
Methods of psychology
Ethical issues
Fields of psychology and their application

Biological Basis of Behaviour

Neuron and its function
Central nervous system
Peripheral nervous system
Endocrine system

Sensation and Perception

Senses: Vision, audition, smell, taste and kinesthetic
Introduction to perception
Gestalt principles

Binocular and monocular cues
Illusions and extra sensory perception

Learning

Definition of learning
Types of learning: Classical and operant conditioning
Punishment and its effects
Latent and observational learning

Memory

Definition and types of memory
Processes and techniques of improving memory
Forgetting: Nature and causes

Cognition and Language

Concept of cognition
Problem solving
Judgment and decision making
Language development
Language and cognition
Language and culture

Intelligence and Creativity

Concept of intelligence
Theories of intelligence
Assessment of intelligence
Mental retardation
Concept of creativity and its stages

Motivation and Emotion

Introduction to motivation
Factors affecting motivation
Introduction to emotions
Types of emotions
Physiology and emotion
Theories of emotion

Personality

Defining personality
Theories of personality
Personality assessment

Social Thinking and Social Influence

Social facilitation
Attribution theory
Crowd behavior
Conformity, Obedience
Helping behavior

Recommended Books

1. Atkinson R. C., & Smith, E. E. (2000).*Introduction to psychology* (13th ed.). NY: Harcourt Brace College Publishers.
2. Coon, D., &Mutterer, J. (2008).*Introduction to psychology: Gateways to mind and behavior* (12th ed.). USA: Wadsworth Cengage Learning.

3. Fernald, L. D., & Fernald, P.S (2005).*Introduction* to psychology.USA; WMC Brown Publishers.
4. Fredrickson, B., Nolen-Hoeksema, S., Loftus, G., & Wagenaar, W. (2009). *Atkinson & Hilgard's introduction to psychology* (15th ed.). USA: Wadsworth.
5. Glassman, W.E. (2000). *Approaches* to psychology.Open University Press.
6. Hayes, N. (2000). *Foundation of psychology* (3rd ed.). UK: Thomson Learning.
7. Kalat, J. W. (2010). *Introduction to psychology*.USA: Cengage Learning, Inc.
8. Lahey, B. B. (2004). *Psychology*: *An introduction* (8th ed.). UK: McGraw-Hill Companies, Inc.
9. Leahey,T. H. (1992). *A history of psychology: Main currents in psychological thought.* New Jersey: Prentice-Hall International, Inc.
10. Myers, D. G. (2011).*Psychology* (10th ed.). USA: Wadsworth Publishers.
11. Ormord, J. E. (1995). *Educational psychology: Developing learners*. USA: Prentice Hall, Inc.
12. Rathus, S. (2011). *Psychology: Concepts and connections* (10th ed.). USA: Wadsworth Cengage

Course Code	Pre-Requisite	Course Title	Credit Hrs
QR-		Basic Mathematics	03

Will upload soon

SECOND YEAR
THIRD SEMESTER

Course Code	Pre-Requisite	Course Title	Credit Hrs
EW-		Technical report writing (Eng-III)	03

Course Description:

The course is designed to help students take a deep approach in reading and writing academic texts which involve effective learning strategies and techniques aimed at improving the desired skills. The course consists of two major parts: the 'reading section' focuses on recognizing a topic sentence, skimming, scanning, use of cohesive devices, identifying facts and opinions, guess meanings of unfamiliar words. The 'writing section' deals with the knowledge and use of various grammatical components such as, parts of speech, tenses, voice, narration, modals etc. in practical contexts.

Course Contents

Reading Skills

- Identifying Main Idea / Topic sentences
- Types of Reading Skills: skimming, scanning, extensive and intensive
- Active and Passive Reading
- Strategies for Improving Reading Skills
- Finding Specific and General Information Quickly
- Distinguishing Between Relevant and Irrelevant Information According to Purpose for Reading

- Recognizing and Interpreting Cohesive Devices
- Distinguishing Between Fact and Opinion
- Reading Comprehension

Writing Skills

- Sentence patterns and structures
- Phrase, clause
- Parts of Speech
- Tenses: meaning and use
- Modals
- Use of active and passive voice
- Reported Speech
- Writing good sentences
- Error Free writing
- Paragraph writing with topic sentence

Recommended Readings/Books

- Howe, D. H, Kirkpatrick, T. A., & Kirkpatrick, D. L. (2004). *Oxford English for undergraduates*. Karachi: Oxford University Press.
- Eastwood, J. (2004). *English Practice Grammar* (New edition with tests and answers). Karachi: Oxford University Press.
- Murphy, R. (2003). *Grammar in use.* Cambridge: Cambridge University Press.

Course Code	Pre-Requisite	Course Title	Credit Hrs
CIV-		Pakistan Study	03

Will upload soon

Course Code	**Course Title**	**Credit hours**
BOT-110	Diversity of Plants	04 (3+1)

Specific Objectives of course:

To introduce the students to the diversity of plants and their structures and significance.

Course Outline:

Comparative study of life form, structure, reproduction and economic significance of:

a) **Viruses** (RNA and DNA types) with special reference to TMV;

b) Bacteria and Cyanobacteria (Nostoc, Anabaena, Oscillatoria) with specific reference to biofertilizers, pathogenicity and industrial importance;

c) Algae (Chlamydomonas, Spirogyra, Chara, Vaucheria, Pinnularia, Ectocarpus, Polysiphonia)

Fungi (Mucor, Penicillium, Phyllactinia, Ustilago, Puccinia, Agaricus), their implication on crop production and industrial applications.

d) Lichens (Physcia)

e) Bryophytes

i Riccia

ii Anthoceros

iii Funaria

f) Pteridophytes.

i Psilopsida (Psilotum)

ii Lycopsida (Selaginella)

iii Sphenopsida (Equisetum)

iv Pteropsida (Marsilea)

g) Gymnosperms

i Cycas

ii Pinus

iii Ephedra

h) Angiosperms

i Monocot (Poaceae)

ii Dicot (Solanaceae)

Lab Outline:

Culturing, maintenance, preservation and staining of microorganisms. Study of morphology and reproductive structures of the types mentioned in theory. Identification of various types mentioned from prepared slides and fresh collections.

Recommended Books:

1. Lee, R. E. 1999. Phycology. Cambridge University Press, UK
2. Prescott, L. M., Harley, J. P. and Klein, A. D. 2004. Microbiology, 3rd Ed. WM. C. Brown Publishers.
3. Alexopoulos, C. J., Mims, C. W. and Blackwell, M. 1996. Introductory Mycology. 4th Ed. John Wiley and Sons Publishers.
4. Agrios, G. N. 2004. Plant pathology. 8th Ed. Academic Press London.

5. Vashishta, B. R. 1991. Botany for degree students (all volumes). S. Chand and Company. Ltd. New Delhi.
6. Andrew, H. N. 1961. Studies in Paleobotany. John Willey and Sons.
7. Ingrouille , M. 1992. Diversity and Evolution of Land Plants. Chapman & Hall.
8. Mauseth**,** J**.** D**.** 2003**.** Botany**:** An Introduction to Plant Biology 3rd Ed., Jones and Bartlett Pub. UK
9. Marti. J. Ingrouille & Plant: Diversity and Evolution. 2006 CUP
10. Taylor, T. N. & Taylor, E. D. 2000. Biology and Evolution of Fossil Plants. Prentice Hall. N. Y.
11. Hussain, F. 2012. A Text Book of Botany and Biodiversity. Pak Book Empire.

Journals / Periodicals:

Pakistan Journal of Botany, American Journal of Botany, Canadian Journal of Botany, Annals of Botany

Course Code	Course Title	Credit hours
BOT-111	Plant Systematics, Anatomy and Development/Embryology	04 (3+1)

Specific Objectives of course: To understand: 1. various systems of classification, identification and nomenclature of Angiosperms, 2- Structures and functions of tissues and organs at embryonic level.

a) Plant systematics

1. Introduction to Plant Systematics: aims, objectives and importance.

2. Classification**:** brief history of various systems of classification with emphasis on Takhtajan.

3. Brief introduction to nomenclature, importance of Latin names and binomial system with an introduction to International Code of Botanical Nomenclature (ICBN).Vienna code.

4. Morphology: a detailed account of various morphological characters root, stem, leaf, inflorescence, flower, placentation and fruit types.

5. Diagnostic characters, economic importance and distribution pattern of the following families:

i. Ranunculaceae ii. Brassicaceae (Cruciferae) iii. Fabaceae (Leguminosae) iv. Rosaceae v. Euphorbiaceae vi Cucurbitaceae vii. Lamiaceae (Labiatae) viii. Apiaceae (Umbelliferae) ix. Asteraceae (Compositae) x. Liliaceae (Sen. Lato).

b) Anatomy

1. Cell wall: structure and chemical composition

2. Concept, structure and function of various tissues like:

i. Parenchyma ii. Collenchyma iii. Sclerenchyma iv. Phloem Epidermis (including stomata and trichomes) v. Xylem

3. Meristem: types, stem and root apices

4. Vascular cambium

5. Structure and development of root, stem and leaf. Primary and secondary growth of dicot stem, periderm

6. Characteristics of wood: diffuse porous and ring porous, sap and heart wood, soft and hard wood, annual rings.

c) Development/Embryology

1. Early development of plant body
2. Capsella bursa-pastoris
3. Structure and development of Anther Microsporogenesis, Microgametophyte
4. Structure of Ovule Megasporogenesis Megagametophyte
5. Endosperm formation 6. Parthenocarpy
7. Polyembryony

Lab Outline:

Plant Systematics

1. Identification of families given in syllabus with the help of keys.
2. Technical description of common flowering plants belonging to families mentioned in theory.
3. Field trips shall be undertaken to study and collect local plants.
4. Students shall submit 40 fully identified herbarium specimens.

Anatomy and Embryology

1. Study of stomata and epidermis. 2. Tissues of primary body of plant. 3. Study of xylem 3-dimensional plane of wood. 4. T. S of angiosperm stem and leaf. 5. Anatomy of germinating seeds 6. Study of pollens.

Recommended Books:

1. Mauseth, J. D. 1998. An Introduction to Plant Biology: Multimedia Enhanced. Jones and Bartlett Pub. UK
2. Moore, R. C., W. D. Clarke and Vodopich, D. S. 1998. Botany. McGraw Hill Company, U.S.A.
3. Raven, P. H., Evert, R. E. and Eichhorn, S. E. 1999. Biology of Plants. W. H. Freeman and Company Worth Publishers.
4. Stuessy, T. F. 1990. Plant Taxonomy. Columbia University Press, USA.
5. Lawrence, G. H. M. 1951 Taxonomy of Vascular Plants. MacMillan & Co. New York.
6. Panday, B. P. 2004. A textbook of Botany (Angiosperms). S. Chand and Co. New Delhi.
7. Raymond E, S. E. Eichhorn. 2005. Esau's Plant Anatomy. Meristems cells and tissues of the plant body, 3rd Ed. John Wiley & Sons. Inc.
8. Fahn, A. 1990. Plant Anatomy. Pergamon Press, Oxford.
9. Esau, K. 1960. Anatomy of Seed Plants. John Wiley, New York.
10. Maheshwari, P. 1971. Embryology of Angiosperms, McGraw-Hill. New York.
11. Eames A. J. and L. H Mac Daniels. 2002. An Introduction to Plant Anatomy. Tata-Mac Graw-Hill Publishing Company, Limited, New Delhi.

12. Pullaiah, T. 2007. Taxonomy of Angiosperms. 3rd Edition, Regency Publications, New Delhi.
13. Naik, V. N. 2005 Taxonomy of Angiosperms. 20th Reprint. TataMacGraw-Hill Publishing Company, Limited New Delhi.
14. Rajput, M. T., S. S. Hassney and K. M. Khan. 1996. Plant Taxonomy. New Trends Computer Service, Hyderabad, Sindh, Pakistan. Journals / Periodicals: Pakistan Journal of Botany, Taxon, Phyton.

Course Code	Course Title	Credit hours
BOT-112	Cell Biology, Genetics and Evolution	04 (3+1)

Specific objectives of course:

To understand:

1. Structure and function of cell.
2. Nature of genetic material and hereditary process
3. Familiarization with evolutionary processes.

Course outline:

a) Cell Biology

1. Structure and Function of Bio-molecules i. Carbohydrates ii. Lipids iii. Proteins iv. Nucleic Acids
2. Cell: Cell theory, cell types (prokaryotes, eukaryotes), basic properties of cell.
3. Brief description of following cell organelles

i Cell wall ii Cell membrane iii Nucleus iv Endoplasmic reticulum v Plastids vi Mitochondria vii Ribosomes viii Dictyosomes ix Vacuoles

4. Reproduction in somatic and embryogenic cell, mitosis, meiosis and cell cycle.

b) Genetics

1. Introduction, scope and brief history of genetics. Mendelian inheritance; Laws of segregation and independent assortment, back cross, test cross, dominance and incomplete dominance.
2. Molecular genetics; DNA replication. Nature of gene, genetic code, transcription, translation, protein synthesis, regulation of gene expression (e.g. *lac* operon).
3. Chromosomal aberrations; Changes in the number of chromosomes. Aneuploidy and Euploidy. Changes in the structure of chromosomes, deficiency, duplication, inversion and translocation.

c) Evolution: Introduction and theories.

Lab Outline:

Cell Biology

1. Study of cell structure using compound microscope and elucidation of ultrastructure from electron microphotographs

2. Measurement of cell size.

3. Study of mitosis and meiosis by smear/squash method and from prepared slides.

4. Study of chromosome morphology and variation in chromosome number.

5. Extraction and estimation of carbohydrate, protein, RNA and DNA from plant sources.

Genetics

1. Genetical problems related to transmission and distribution of genetic material.

2. Identification of chromosomes in plant material. Carmine/orcein staining.

3. Determination of blood groups

Recommended Books:

1. Hoelzel, A. R. 2001. Conservation Genetics. Kluwer Academic Publishers.

2. Dyonsager, V. R. (1986). Cytology and Genetics. Tata and McGraw-Hill Publication Co. Ltd,, New Delhi. 3. Lodish. H. 2001. Molecular Cell Biology. W. H. Freeman and Co.

4. Sinha, U. and Sinha, S. (1988). Cytogenesis Plant Breeding and Evolution, Vini Educational Books, New Delhi.

5. Strickberger, M. V. (1988), Genetics, MacMillan Press Ltd., London.

6. Carroll, S. B., Grenier, J. K. and Welnerbee, S. D. 2001. From DNA to Diversity - Molecular Genetics and the Evolution of Animal Design. Blackwell Science.

7. Lewin, R, 1997. Principles of Human Evolution. Blackwell Science.

8. Strickberger, M. W. 2000 Evolution. Jones & Bartlet Publishers Canada

9. Ingrouille M. J. & B. Eddie. 2006. Plant Diversity and Evolution. Cambridge University Press.

10.Bruce Albert et al. 2009. Essential cell biology. Garland Sciences Publishers. Journals/Periodicals: Theoretical & Applied Genetics, the Cell, Heredity.

Course Code	Pre-Requisite	Course Title	Credit Hrs
BOT-120	Foundation-IV	Plant Physiology and Ecology	04 (3+1)

Specific objectives of course:

1. To provide comprehensive knowledge of functioning of organs, organelles and biomolecules,

2. To enable the students to assess the effects of various environmental factors on plant growth and development.

Course Outline:

a) Plant Physiology

1. Water relations (water potential, osmotic potential, pressure potential, matric potential). Absorption and translocation of water. Stomatal regulation.

2. Mineral nutrition: Soil as a source of minerals. Passive and active transport of nutrients. Essential mineral elements, role and deficiency symptoms of macronutrients.

3. Photosynthesis: Introduction, Oxygenic and non-oxygenic photosynthesis Mechanism: light reactions (electron transport and photophosphorylation) and dark reactions (Calvin cycle). Differences between C3 and C4 plants. Factors affecting this process, Products of photosynthesis.

4. Respiration: Definition and respiratory substrates. chanism-Glycolysis, Krebs cycle. Electron transport and oxidative phosphorylation. Anaerobic respiration. Energy balance in aerobic and naerobic respiration, Respiratory quotients.

b) Ecology

1. Introduction, aims and applications of ecology.

2. Soil: Physical and Chemical properties of soil (soil formation, texture. pH, EC, organism and organic matter etc) and their relationships to plants.

3. Light and Temperature. Quality of light, diurnal and seasonal variations. Ecophysiological responses. 4. Water: Field capacity and soil water holding capacity. Characteristics of xerophytes and hydrophytes. Effect of precipitation on distribution of plants.

5. Wind: Wind as an ecological factor and its importance.

6. Population Ecology: Introduction. A brief description of seed dispersal and seed bank.

7. Community Ecology

i. Ecological characteristics of plant community ii. Methods of sampling vegetation (Quadrat and line intercept) iii. Major vegetation types of the local area.

8. Ecosystem Ecology

i. Definition, types and components of ecosystem. ii. Food chain and Food web.

9. Applied Ecology: Causes, effects and control of water logging and salinity with respect to Pakistan.

Lab Outline:

a) Plant Physiology

1. Preparation of solutions of specific normality of acids/bases, salts, sugars, molal and molar solutions and their standardization.

2. Determination of uptake of water by swelling seeds when placed in sodium chloride solution of different concentrations.

3. Measurement of leaf water potential by the dye method.

4. Determination of the temperature at which beet root cells lose their permeability.

5. Determination of the effects of environmental factors on the rate of transpiration of a leafy shoot by means of a porometer/cobalt chloride paper method.

6. Extraction of chlorophyll from the leaves and separation of component pigments on a paper chromatogram. Study of absorption spectra using spectrophotometer.

7. Estimation of oxygen utilized by a respiring plant by Winkler's method.

b) Ecology

1. Determination of physical and chemical characteristics of soil.

2. Measurements of various population variables

3. Measurement of vegetation by Quadrat and line intercept methods.

4. Field trips to ecologically diverse habitats.

5. Measurements of wind velocity.

6. Measurement of light and temperature.

7. Effect of light and temperature on seed germination.

Recommended Books:

1. Ihsan, I. 1995. Plant Physiology, Biochemical Processes in Plants, UGC Press.

2. Witham and Devlin. 1986 Exercises in Plant Physiology, AWS Publishers, Boston.

3. Taiz, L. and Zeiger, E. 2006. Plant Physiology. 4th. Ed. Sinauers Publ. Co. Inc. Calif.

4. Salisbury F. B. and Ross C. B. 1992. Plant Physiology. 5th Edition. Wadsworth Publishing Co. Belmont CA.

5. Hopkins, W. B. 1999. Introduction to Plant Physiology. 2nd Ed. John Wiley and Sons. New York

6. Schultz, J. C. 2005. Plant Ecology. Springer-Verlag, Berlin.

7. Ricklefs, R. E. 2000. Ecology. W. H. Freeman and Co., UK.

8. Ricklefs, R. E. 2001. The Economy of Nature. W. H. Freeman and Co., UK.

9. Barbour, M. G., J. H. Burke and W. D. Pitts. 1999. Terrestrial Plant Ecology, The Benjamin, Cumming Publishing Co. Palo Alto, California, USA.

10. Chapman, J. L. and Reiss, M. J. 1995. Ecology: Principles and Applications. Cambridge University Press. 11. Hussain F. 1989. Field and Laboratory Manual of Plant Ecology. National Academy of Higher Education, Islamabad.

12. Hussain, S. S. 1989. Pakistan Manual of Plant Ecology; National Book Foundation, Islamabad.

13. Larcher, W. 2003 Physiological Plant Ecology: Ecophysicology and Stress Physiology of Functions Groups – Springer Verlag.

14. Krebs, C. J. 1997. Ecology. Harper and Row Publishers.

15. Smith, R. L. 1996. Ecology and Field Biology. Addison Wesley Longman, Inc., New York.
16. Smith, R. L. 1998. Elements of Ecology. Harper and Row Publishers, New York.
17. Smith, R. L. 2004.Ecology and field biology. Addison Wesley Longman, Inc., New York.
18. Subrahmanyam, N. S. and Sambamurthy, A. V. S. S. 2000. Ecology. Narosa Publishing House, New Delhi. 19. Townsend, C. R., Harper, J. L. and Begon, M. E. 2002. Essentials of Ecology. Blackwell Scientific Publications, UK.
20. Odum, E. P. 1985. Basic Ecology. W. B. Saunders.
Journals / Periodicals: Plant Physiology, Journal of Ecology.

Course Code	Pre-Requisite	Course Title	Credit Hrs
BOT-121	Foundation-V	Biodiversity and Conservation	04 (3+1)

Specific objectives of course:

To familiarize the students with the diversity of nature. Importance of biodiversity for survival and proper functioning of ecosystems.

Course Outline:

1. Biodiversity: Definition, types and threats
2. Threats to Biodiversity; deforestation, over grazing, erosion, desertification, ecosystem degradation, bio invasion, pollution and climate change
3. Biodiversity of Pakistan
4. Measuring biodiversity: Alpha, Beta and Gamma diversity; Systematic and functional diversity.
5. Ecological services, indirect value of ecosystem by virtue of their ecological functions, direct value of ecosystem (i.e. Utility of Bio resources)
6. Sustainable and unsustainable use of biological resources
7. Biodiversity Hot spots of Pakistan and the world.
8. International treaties/agreements regarding Biodiversity and conservation; CBD, CITES, Ramsar

9 Conservation strategies; in situ, ex situ, in vitro conservation

10. Conservation vs preservation
11. IUCN categorized protected areas in Pakistan; red listing
12. Environmental Impact Assessment.
13. Use of herbarium and Botanical Garden in biodiversity and conservation.
14. Concept of pastures and wild life management
15. Global Biodiversity Information Facility (GBIF)

Lab outline:

1 Inventory of plant biodiversity in various habitats.

2 Field survey for baseline studies and Impact Assessment.

3 Identification of wild plant species used by local communities in different ecosystems.

Recommended Books:

1. Abbasi, A. M., Khan, M. A., M. Ahmad and M. Zafar. 2012. Medicinal plant biodiversity of Lesser Himalaya Pakistan. Springer Publishers USA.

2. Hussain, F., 1991. Vegetation and ecology of lesser Himalaya. Department of Botany, Peshawar

3. Shinwari, M. I. and M. A. Khan. 1998. Ethnobotany of Margalla Hills. Department of Biological Sciences, Quaid-i-Azam University Islamabad Pakistan.

4. Shinwari, M. I., M. I. Shinwari and Shah, M. 2007. Medicinal Plants of Margalla Hills National Park Islamabad. Higher Education Commission Islamabad. Pp.218.

5. Provincial conservation strategies

6. Heywood, V. (ed.). 1995. Global Biodiversity Assessment. Published for the United Nations Environment Programme. Cambridge University Press, Cambridge, UK.

7. Falk, D. A. & Holsinger, K. E. 1991. Genetics and Conservation of Rare Plants. Center for Plant Conservation. Oxford University Press, Oxford, UK.

8. Frankel, O. H., Brown, A. H. D. & Burdon, J. J. 1995. The Conservation of Plant Biodiversity. Cambridge University Press, Cambridge, UK.

9. IUCN. 1994. IUCN Red List Categories. As Approved by the IUCN Council. IUCN.

10. Leadlay, E. and Jury, S. 2006 Taxonomy and Plant Conservation. CUP.

11. Bush, M. B. 1997 Ecology of a changing Planet. Prentice hall. New Jersy.

12. French, H. 2000 Vanishing Borders- protecting the Planet in the age of globalization. W. W. Norton & Co.

13. Swanson, T. 2005 Global Action for Biodiversity. Earth Scan Publication Ltd. 14. Taylor, P. 2005 Beyond Conservation. Earth Scan Publication Ltd.

Journals /Periodicals: Systematics and Biodiversity, Biological Conservation.

Course Code	Pre-Requisite	Course Title	Credit Hrs
BOT-122		Biostatistics	03 (2+1)

Course outline:

1. Introduction objectives and scope: i. Definition ii. Characteristics iii. Importance and limitations iv. Population and samples

2. Frequency distribution: i. Variable types ii. Formation of frequency table from raw data iii. Summation, notation and statistical inference iv. Data transformation.

3. Measures of central tendencies and dispersion: i. Arithmetic mean ii. Median iii. Mode iv. Range v. Variance vi. Standard deviation vii. Standard error of the mean viii. Mean deviation.

4. Organizing and describing data (Standard distributions):

i. Random sampling and the binomial distribution

ii. Probability, Types of Probabilities, Random variables, Combining probabilities, Probability distributions, Binomial distributions.

iii. Poisson and normal distributions, properties and applications.

5. Basic experimental design: i. Concept and design ii. Principles of experiments iii. Observational studies iv. Planning of experiments v. Replication and randomization vi. Field plot technique vii. Layout and analysis of completely randomized design viii. Randomized complete block design ix. Latin square x. Factorial design xi. Treatment comparison.

6. Tests of significance: i. T-test: (Basic idea, confidence limits of means, significant difference of means.

ii. Chi square test: Basic idea, testing goodness of fit to a ratio, testing association (contingency table).

iii. F-test: Introduction and application in analysis of variance. iv. LSD test, Duncan's New Multiple Range test (for comparison of individual means). Bonferroni test.

7. Introduction to comparing of means: Unit organization, Basic one way ANOVA, Types of sums of squares, How ANOVA works, The ANOVA Table. Two-way ANOVA-Factorial designs: (two-way factorial analysis, calculating and analyzing the two-way ANOVA, Linear combination, multiple comparisons.

8. Correlation and Regression.

Lab outline:

1. Data collection, arrangement of data in frequency table, calculating frequency, cumulative frequency and preparation of Ogive.

2. Calculating different measure of central tendency such as arithmetic means, harmonic mean, geometric mean, median and mode.

3. Calculation of mean from grouped and ungrouped data.

4. Calculation of variance and standard deviation from grouped and ungrouped data.

5. Calculating dispersion, relative dispersion, standard deviation, standard error, standard score and co-efficient variation by hand and machine method.

6. Problems concerning probability, binomial distribution, T-test

7. Chi square test.

8. Analysis of variance - one factor design.

9. Multiple Analyses of Variance.

10. Determination of correlation by constructing different types of graphs such as scatter diagram, linear positive correlation, linear perfect negative correlation, no correlation and curvilinear correlation (second degree polynomial, third degree polynomial).

11. Linear Regression and multiple regression models.

12. MS Excel, MSTAT or relevant statistical software packages

Recommended Books:

1. Harvey, M. 1995. Intuitive Bioostatistics. Oxford University Press. NY. Kuzma J. W. and Bohnenblust, S. E. 2001, Basis Statistics for the Health Sciences, McGraw-Hill International Education.

2. Onton, P., Adams, S. and Voelkar, D. H. 2001. Cliffnotes for statistics. Blackwell Scientific Publishers.

3. Pacano, M. and Gauvreau, K. 2000. Principles of Biostatistics.

4. Quinn, G. 2002. Experimental Design and Data Analysis for Biologists. Cambridge University Press.

5. Rosner, B. 2005. Fundamentals of Biostatistics. John Wiley & Sons.

6. Samuels, M. L. and Witmar, J. A. 2003. Statistics for life sciences. 3rd Edition. Cambridge University Press.

7. Triola, M. F. and Triola, M. M. 2005. Biostatistics for Biological and Health Sciences. Pearson Addison Wesley. 8. Zar, J. H., 1999. Biostatistical Analysis, Pearson Education.

Course Code	Pre-Requisite	Course Title	Credit Hrs
BOT-123	Foundation-VI	Bacteriology and Virology	03 (2+1)

Specific objectives of course:

To understand the morphology, structure and economic importance of Viruses and Bacteria

Course outline:

a) Viruses

1. General features of viruses, viral architecture, classification, dissemination and replication of single and double – stranded DNA/RNA viruses.
2. Plant viral taxonomy.
3. Virus biology and virus transmission.
4. Molecular biology of plant virus transmission.
5. Symptomatology of virus-infected plants: (External and Internal symptoms).
6. Metabolism of virus-infected plants.
7. Resistance to viral infection.
8. Methods in molecular virology.

b) Bacteria

1. History, characteristics and classification.
2. Evolutionary tendencies in Monera (Bacteria, actinomycetes and cyanobacteria)
3. Morphology, genetic recombination, locomotion and reproduction in bacteria
4. Bacterial metabolism (respiration, fermentation, photosynthesis and nitrogen fixation)
5. Importance of bacteria with special reference to application in various modern sciences specially agriculture, biotechnology and genetic engineering.
6. Symptoms and control of major bacterial diseases in Pakistan

c) Plant microbe interaction

Lab outline:

a) Viruses

Observation of symptoms of some viral infected plant specimens.

b) Bacteria, Actinomycetes and Cyanobacteria

1. Methods of sterilization of glassware and media etc.
2. Preparation of nutrient medium and inoculation.
3. Preparation of slides for the study of various forms, capsule/slime layer, spores, flagella and Gram-staining.

4. Growth of bacteria, subculturing and identification of bacteria on morphological and biochemical basis (using available techniques).

5. Microscopic study of representative genera of Actinomycetes and Cyanobacteria from fresh collections and prepared slides.

Recommended Books:

1. Black, J. G. 2005 Microbiology - Principles and Exploration, John Wiley and Sons, Inc.

2. Prescott, L. M., Harley, J. P. and Klein, D. A. 2005. Microbiology McGraw-Hill Companies, Inc.

3. Arora, D. R. 2004. Textbook of Microbiology, CBS Publishers and Distributors, New Delhi.

4. Ross F. C. 1995. Fundamentals of Microbiology. John Willey & Sons, New York.

5. Khan, J. A. and Dijkstra J. Plant Viruses as Molecular Pathogens. The Haworth Press, Inc.

6. Hull R. Matthews, 2004, Plant Virology, Academic Press.

7. Tortora, G. J: Funke, B. R. and Case C. L., 2004, Microbiology. Pearson Education.

8. Molecular Plant-Microbe Interactions, Kamal Bouarab, Normand Brisson, Fouad Daayf (eds), 2009 MPG Books Group, Bodmin, UK.

9. Plant-Microbe Interactions Gary Stacey, Noel T. Keen (Eds) 2011, springer London.

Journals/Periodicals: World Journal of Microbiology & Biotechnology, Current Microbiology, Journal of Industrial Microbiology and Biotechnology, Journal of General Virology, Journal of Virology

Course Code	Pre-Requisite	Course Title	Credit Hrs
BOT-124	Major-I	Phycology and Bryology	03 (2+1)

Specific objectives of course:

To understand the classification, morphology and economic importance of Algae and Bryophytes .

Course Outline:

a) Phycology

Introduction, general account, evolution, classification, biochemistry, ecology and economic importance of the following divisions of algae: Chlorophyta, Charophyta, Xanthophyta, Bacillariophyta, Phaeophyta and Rhodophyta.

b) Bryology

Introduction and general account of bryophytes, classification, theories of origin and evolution. Brief study of the classes: Hepaticopsida, Anthoceropsida and Bryopsida.

Lab Outline:

a) Phycology:

i. Collection of fresh water and marine algae. ii. Identification of benthic and planktonic algae iii. Section cutting of thalloid algae iv. Preparation of temporary slides v. Use of camera lucida/micrographs.

b) Bryology Study of the following genera: Pellia, Porella, Anthoceros and Polytrichum.

Recommended Books:

1. Bold, H. C. and M. J. Wynne 1985. Introduction to Algae: structure and reproduction. Prentice Hall Inc. Engle Wood Cliffs

2. Lee. R. E. 1999. Phycology. Cambridge University Press, U.K.

3. Dawson, E. Y., Halt. 1966. Marine Botany. Reinhart and Winstan, New York.

4. Chapman, V. J. and D. J. Chapman. 1983. Sea weed and their uses. MacMillan and Co. Ltd. London.

5. Vashishta. B. R. 1991. Botany for degree students. Bryophytes 8th ed. S. Chand and Co. Ltd. Delhi.

6. Schofield, W. B. 1985. Introduction to Bryology. MacMillan Publishing Co. London.

7. Hussain, F. and I. Ilahi. 2012. A text book of Botany. Department of Botany, University of Peshawar.

8. Barsanti, L. and P. G. Gualtieri. 2006. Algae, anatomy, biochemistry, biotechnology. Taylor and Francis, New York.

9. Vashishta, B. R., A. K. Sinha and A. Kumar. 2010. Algae. S. Chand & Co.

10. Bellinger, E. G. and D. C. Sigee. 2010. Fresh water algae (Identification and use as bioindicators). John Wiley & Sons.

11. Hussain, F. 2013. Phycology. A text book of Algae. Pak Book Empire Lahore.

12. Vashishta, B. R., A. K. Sinha and A. Kumar. 2010. Bryophytes. S. Chand & Co. New Delhi.

13. Fida Hussain, Habib Ahmad and Syed Zahir Shah. 2012. The unicellular algae of District Peshawar, Pakistan. Lambert Publication, Germany. Journals / Periodicals: Pakistan Journal of Botany, International Journal of Phycology and Phyco- chemsitry, Bryology, Phycology.

Course	Pre-Requisite	Course Title	Credit Hrs
BOT-210	Major-II	Mycology and Plant Pathology	03 (2+1)

Specific Objectives of course:

To introduce the students to Mycology and Diseases caused by Fungi.

Course Outline:

a) Mycology

1. Introduction: General characters of fungi, Thallus, cell structure and ultrastructure of fungi.

2. Reproduction: Asexual and sexual reproduction and reproduction structures, life cycle, haploid, heterokaryotic and diploid states.

3. Fungal Systematics: Classification of fungi into phyla with suitable examples to illustrate somatic structures, life cycle and reproduction of Myxomycota, Chytridiomycota, Zygomycota (Mucrales) Oomycota (Peronosporales), Ascomycota (Erysiphales, Pezizales), Basidiomycota (Agaricales, Polyporales, Uredinales, Ustilaginales) and Deuteromycetes.

4. Symbiotic relationships of fungi with other organisms (lichens and mycorrhiza) and their significance.

5. Importance of fungi in human affairs with special reference to Industry and Agriculture.

b) Pathology

1. Introduction and classification of plant diseases.

2. Symptoms, causes and development of plant diseases

3. Loss assessment and disease control

4. Epidemiology and disease forecast

5. Important diseases of crop plants and fruit trees in Pakistan caused by fungi, e.g. damping off, mildews, rusts, smuts, dieback, red rot of sugarcane etc.

6. Systemic resistance: Induced systematic resistance (ISR), Acquired Systematic resistance (ASR).

Lab Outline:

a) Mycology General characters and morphology of fungi. Study of unicellular and mycelial forms with septate and aseptate hyphae. Distinguishing characters of different phyla: study of suitable examples. Study of asexual and sexual reproductive structures in different groups of fungi. Study of some common examples of saprophytic, parasitic and air-borne fungi belonging to different phyla.

b) Pathology Identification of major plant pathogens under lab and field conditions, cultural studies of some important plant pathogenic fungi, application of Koch's postulates for confirmation of pathogencity. Demonstration of control measures through chemotherapeutants.

Recommended Books:

1. Agrios, G. N., 2005. Plant Pathology, Academic Press, London.

2. Ahmad, I. and Bhutta, A. R., 2004. Textbook of Introductory Plant Pathology. Book Foundation, Pakistan.

3. Alexopoulos, C. J., Mims, C. W. and Blackwell, M., 1996. Introductory Mycology, 4 th Ed. John Wiley & Sons.

4. Khan, A. G. and Usman, R., 2005. Laboratory Manual in Mycology and Plant Pathology. Botany Department Arid Agriculture University, Rawalpindi.

5. Mehrotra, R. S. and Aneja, K. R., 1990. An Introduction to Mycology. Wiley and Eastern Ltd., New Delhi, India.

6. Moore-Landecker, E., 1996. Fundamentals of Fungi. 4th Edn. Prentice Hall Inc., New Jersey, USA.

7. Trigiano, R. N., Windham, M. T. and Windham, A. S., 2004. Plant Pathology: Concepts and Laboratory Exercises. CRC Press, LLC, N.Y.

Journals / Periodicals: Pakistan Journal of Botany, Mycotoxin, Mycopath, Phytopathology, Australasian Journal of Plant pathology , Asian Journal of Plant Pathology, Annual Review of Plant Pathology.

Course	Pre-Requisite	Course Title	Credit Hrs
BOT-211	Foundation-VII	Diversity of Vascular Plants	03 (2+1)

Specific Objectives of Course:

To enable the students to understand and appreciate the biology and evolution of plant architecture.

Course Outline:

a) Pteridophytes

Introduction, origin, history, features and a generalized life cycle. Methods of fossilization, types of fossils, geological time scale and importance of paleobotany. First vascular plant - Rhyniophyta e.g. Cooksonia General characters, classification, affinities and comparative account of evolutionary trends of the following phyla: Psilopsida Psilotum), Lycopsida (Lycopodium, Selaginella), Sphenopsida (Equisetum), Pteropsida (Ophioglossum, Dryopteris and Azolla/Marsilea).

b) Origin and Evolution of seed habit.

c) Gymnosperms: Geological history, origin, distribution, morphology, anatomy, classification and affinities of Cycadofillicales, Bennettitales, Ginkgoales, Cycadales and Gnetales. Distribution of gymnosperms in Pakistan. Economic importance of gymnosperms. An introduction to the Gondwana flora of world.

d) Angiosperms: Origin, general characteristics, Importance, and life cycle of angiosperms

e) Palynology:

1. An introduction to Neopalynology and Paleopalynology, its applications in botany, geology, archaeology, criminology, medicines, honey and oil and gas exploration.

2. Basic information about the nomenclature, morphology and classification of living and fossil pollen and spores.

Lab Outline:

1. To study the morphological and reproductive features of available genera.
2. Study trips to different parts of Pakistan for the collection and identification of important pteridophytes, gymnosperms and angiosperms.
3. Study of pollen morphology

Recommended Books:

1. Beck, C. B. 1992. Origin and Evolution of Gymnosperms. Vol-1&II, Columbia University Press, New York, 2. Foster, A. S. and Gifford, E. M. Jr. 1998. Comparative Morphology of Vascular Plants. W. H. Freeman and Co.
3. Jones, D. 1983. Cycadales of the World, Washington, DC.
4. Mauseth, J. D. 1998. An Introduction to Plant Biology, Multimedia Enhanced, Jones and Bartlett Pub. UK.
5. Moore, R. C., W.d. Clarke and Vodopich, D. S. 1998. Botany McGraw-Hill Company, USA
6. Raven, P. H. Evert, R. E. and Eichhorn, S. E. 1999. Biology of Plants, W. H. Freeman and Company Worth Publishers.
7. Ray, P.M. Steeves, T. A. and Fultz, T. A. 1998. Botany Saunders College Publishing, USA.
8. Taylor, T. N. and Taylor, E. D. 2000. The Biology and Evolution of Fossil Plants, Prentice Hall.
9. Stewart, W. N. and Rothwell, G. W. 1993. Paleobotany and the Evolution of Plants, University Press, Cambridge.
10. Faegri, K., P. E. Kaland & K. Krzywinski 1989. Text Book of Pollen Analysis, John Wiley & Sons. N. Y.
11. Vashishta, B. R., A. K. Sinha and A. Kumar. 2010. Pterodophyta. S. Chand & Co. New Delhi
12. B. P. Panday. 2006. College Botany. Vol 1 & II. S. 7 th Edition. Chand & Co. New Delhi
13. Vashishta, B. R., A. K. Sinha and A. Kumar. 2010. Gymnosperms. S. Chand & Co.

Journals / Periodicals: Pakistan Journal of Botany, New Phytologist, Review of Palaeobotany & Palynology, Palaeontographica, Palaeobotanist.

Course	Pre-Requisite	Course Title	Credit Hrs
BOT-212	Major-III	Plant Systematics	03 (2+1)

Specific Objectives of course:

To know floral composition/system of classification focusing on identification, classification, description nomenclature and flora writings, monographs.

Course Outline:

1. Introduction: Importance and relationship with other sciences, Phases of plant taxonomy. Origin and radiation of angiosperm, their probable ancestors, when, where and how did the angiosperms evolve; the earliest fossil records of angiosperms.

2. Concept of Species: What is a species? Taxonomic species, Biological species, Micro and macro species, Species aggregate. Infra specific categories.

3. Speciation: Mechanism of speciation, Mutation and hybridization Geographical isolation, Reproductive isolation, Gradual and abrupt.

4. Variation: Types of variation, Continuous and discontinuous variation, Clinal variation.

5. Systematics and Genecology / Biosystematics: Introduction and importance, Methodology of conducting biosystematics studies, Various biosystematics categories such as ecophene, ecotype, ecospecies, coenospecies and comparium.

6. Taxonomic Evidence: Importance and types of taxonomic evidences: anatomical, cytological, chemical, molecular, palynological, geographical and embryological.

7. Nomenclature : Important rules of botanical nomenclature including effective and valid publication, typification, principles of priority and its limitations, author citation, rank of main taxonomic categories, conditions for rejecting names.

8. Classification: Why classification is necessary? Importance of predictive value. Brief history, Different systems of classification with at least one example of each (Linnaeus, Bentham and Hooker, Engler and Prantl, Bessey, Cronquist, Takhtajan, and Dahlgren.

9. Brief introduction of Numerical taxonomy.

10. General characteristics, distribution, evolutionary trends, phyletic relationships and economic importance of the following families of angiosperm:

1. Apiaceae (Umbelliferae) 2. Arecaceae (Palmae) 3. Asclepiadaceae 4. Asteraceae (Compositae)

5. Boraginaceae 6. Brassicaceae (Cruciferae) 7. Capparidaceae 8. Caryophyllaceae 9. Chenopodiaceae 10. Convolvulaceae 11. Cucurbitaceae 12. Cyperaceae 13. Euphorbiaceae 14. Fabaceae (Leguminosae) 15. Lamiaceae (Labiatae) 16. Liliaceae 17. Magnoliaceae 18. Malvaceae 19. Myrtaceae 20. Orchidaceae

21. Papaveraceae 22. Poaceae (Gramineae) 23. Ranunculaceae 24. Rosaceae 25. Salicaceae 26. Scrophulariaceae 27. Solanaceae

Lab Outline:

1. Technical description of plants of the local flora and their identification up to species level with the help of a regional/Flora of Pakistan
2. Preparation of indented and bracketed types of keys
3. Preparation of permanent slides of pollen grains by acetolysis method and study of different pollen characters.
4. Study of variation pattern in different taxa.
5. Submission of properly mounted and fully identified hundred herbarium specimens at the time of examination
6. Field trips shall be undertaken to study and collect plants from different ecological zones of Pakistan.

Recommended Books:

1. Ali, S. I. and Nasir, Y. 1990-92. Flora of Pakistan. Karachi Univ. Press, Karachi
2. Ali, S. I. and Qaiser, M. 1992-2007 -todate. Flora of Pakistan. Karachi Univ. Press, Karachi.
3. Greuter, W., McNeill, J., Barrie, F. R., Burdet, H. M., Demoulin, V., Filguerras, T. S., Niclson, D. H. Silva, P. C., Skog, J. E., Trehane, P.,Turland, N. J. & Hawksworth, D.L.,(eds.) 2000. International code of botanical nomenclature (Saint Louis Code) adopted by the Sixteenth International botanical congress St. Louis Missouri, July –August 1999. Koeltz, Konigstein. (Regnum Veg.138.)
4. Davis, P. H. & Heywood, V. H. 1963. Principles of Angiosperm Taxonomy. Oliver & Boyd, London
5. Ingrouille, M. 1992. Diversity and Evolution of Land Plants, Chapman & Hall. London
6. Nasir, E. & Ali, S. I. 1970-89. Flora of Pakistan. Karachi Univ. Press, Karachi.
7. Stace, C. (1992). Plant Taxonomy and Biosystematics, Edward Arnold.
8. Takhtajan, A. (1986). Flowering Plant: Origin and Dispersal, Oliver and Boyd, Edinburgh
9. Jones, S. B. and Luchsinger, A. E. 1987. Plant Systematics. McGraw-Hill, Inc. New York.
10. Naik, V. N. 2005. Taxonomy of Angiosperms. Tata McGraw-Hill Publishing Company, New Delhi.
11. Stussy, T. F. 1990. Plant Taxonomy, Columbia University Press, USA.
12. Jeffrey C. 1980. An Introduction to Plant Taxonomy. Cambridge University Press.UK
13. Levin, D. A. 2000. The Origin, Expansion and Demise of Plant Species. Oxford University Press.
14. Shinwari, M. I. and M. A. Khan. 1998. Ethnobotany of Margalla Hills. Department of Biological Sciences, Quaid-i-Azam University Islamabad Pakistan.
15. Shinwari, M. I., M. I. Shinwari and Shah, M. 2007. Medicinal Plants of Margalla Hills National Park Islamabad. Higher Education Commission Islamabad. Pp.218.

16. Sivarajan V. V and N. K. P Robson 1991 Introduction to the Principles of Plant Taxonomy.
17. Radford, A. E., W. C. Dickison, J. R. Massey, and C. R. Bell. 1998 Vascular Plant Systematic. Harper and Row, New York.
18. Leadlay, E. and Stephen 2006. Taxonomy and Plant Conservation.
19. Rajput, M. T., S. Saliha and K. M. Khan. 1996 Plant Taxonomy. Nasim Book Depot Hyderabad.
20. Heywood V. H. 1978. Flowering Plants of the World. Oxford University Press.
21. Simpson, M. G. 2006. Plant Systematics. Elsevier Academic Press.
22. Soltis, D. E. P. S. Soltis, P. K Endress, and M. W. Chase, 2005. Phylogeny & evolution of angiosperms. Sinauers associates, Inc. Publishers.
23. Pullaiah, T. 2007 Taxonomy of Angiosperms 3rd Ed. Regency Publication, New Delhi.

Journals / Periodicals: Pakistan Journal Botany, Flora of Pakistan, Taxon, Botanical Journal of the Linnaean Society.

Course	Pre-Requisite	Course Title	Credit Hrs
BOT-213	Foundation-VIII	Plant Anatomy	03 (2+1)

Specific objectives of course:

To provide the students understanding about anatomical features of vascular plants

Course Outline:

1. The plant body and its development: fundamental parts of the plant body, internal organization, different tissue systems of primary and secondary body.
2. Meristematic tissues: classification, cytohistological characteristics, initials and their derivatives.
3. Apical meristem: Delimitation, different growth zones, evolution of the concept of apical organization. Shoot and root apices.
4. Leaf: types, origin, internal organization, development of different tissues with special reference to mesophyll, venation, bundle-sheaths and bundle-sheath extensions. Enlargement of epidermal cells.
5. Vascular cambium: Origin, structure, storied and non-storied cell types, types of divisions: additive and multiplicative; cytoplasmic characteristics, seasonal activity and its role in the secondary growth of root and stem. Abnormal secondary growth.
6. Origin, structure, development, functional and evolutionary specialization of the following tissues: Epidermis and epidermal emergences, Parenchyma, Collenchyma, Sclerenchyma, Xylem, Phloem with special emphasis on different types of woods, Periderm.

7. Secretory tissues: Laticifers (classification, distribution, development, structural characteristics, functions) and Resin Canals.

8. Anatomy of reproductive parts: a. Flower b. Seed c. Fruit

9. Economic aspects of applied plant anatomy

10. Anatomical adaptations

11. Molecular markers in tree species used for wood identification.

Lab outline:

1. Study of organization of shoot and root meristem, different primary and secondary tissues from the living and preserved material in macerates and sections, hairs, glands and other secondary structures.

2. Study of abnormal/unusual secondary growth.

3. Peel and ground sectioning and maceration of fossil material.

4. Comparative study of wood structure of Gymnosperms and Angiosperms with the help of prepared slides.

Recommended Books:

1. Dickison, W. C. 2000. Integrative plant anatomy. Academic Press, U. K.

2. Fahn, A. 1990. Plant Anatomy. Pergamum Press, Oxford.

3. Esau, K. 1960. Anatomy of Seed Plants. John Wiley, New York.

4. Metcalf, C. R. and Chalk, L. 1950. Anatomy of the Dicotyledons. Clerondon Press. Oxford.

5. Anon. Manual of Microscopic Analysis of Feeding Stuffs. The American Association of feed Microscopists.

6. Vaughan, J. G. 1990. The structure and Utilization of Oil Seeds. Chapman and Hall Ltd. London.

7. Metcalfe, C. R. 1960. Anatomy of the Monocotyledons. Gramineae. Clerondon Press, Oxford.

8. Metcalfe, C. R. 1971. Anatomy of the Monocotyledons.V. Cyperaceae. Clerondon Press, Oxford.

9. Cutler, D. F. 1969. Anatomy of the Monocotyledons. IV. Juncales. Clarendon Press, Oxford.

10. Cutler, D. F. 1978. Applied Plant Anatomy. Longman Group Ltd. England

11. Raymond, E. S. and E. Eichhorn. 2005. Esau's Plant Anatomy; Meristematic cells and tissues of plant body. John Willey Sons.

12. Eames, A. J. and L. H. Mac Daniels. 2002. An introduction to Plant Anatomy. Tat McGraw-Hill Publishing Company Limited, New Delhi.

Journals / Periodicals: Pakistan Journal of Botany

Course	Pre-Requisite	Course Title	Credit Hrs
BOT-214	Major-IV	Genetics-I	03 (2+1)

Specific Objectives of course:

To understand the nature and function of genetic material

Course Outline:

1. Extensions of Mendelian Analysis: Variations on dominance, multiple alleles, lethal alleles, several genes affecting the same character, penetrance and expressivity.

2. Linkage I: Basic Eukaryotic Chromosome Mapping : The discovery of linkage, recombination, linkage symbolism, linkage of genes on the X chromosome, linkage maps, three-point testcross, interference, linkage mapping by recombination in humans,

3. Linkage II: Special Eukaryotic Chromosome Mapping Techniques: Accurate calculation of large map distances, analysis of single meioses, mitotic segregation and recombination, mapping human chromosomes.

4. Recombination in Bacteria and their Viruses: Bacterial chromosome, bacterial conjugation, bacterial recombination and mapping the E.coli chromosome, bacterial transformation, bacteriophage genetics, transduction, mapping of bacterial chromosomes, bacterial gene transfer.

5. The Structure of DNA: DNA: The genetic material, DNA replication in eukaryotes, DNA and the gene.

6. The Nature of the Gene: How genes work, gene- protein relationships, genetic observations explained by enzyme structure, genetic fine structure, mutational sites, complementation.

7. DNA Function: Transcription, translation, the genetic code, protein synthesis, universitality of genetic information transfer, eukaryotic RNA.

8. The Extranuclear Genome : Variegation in leaves of higher plants, cytoplasmic inheritance in fungi, extranuclear genes in chlamydomonas, mitochrondrial genes in yeast, extragenomic plasmids in eukaryotes.

9. Developmental Genetics: Gene Regulation and Differentiation, Crown gall disease in plants, cancer as a developmental genetic disease.

10. Population Genetics**:** Gene frequencies, conservation of gene frequencies, equilibrium, Hardy-Weinberg law, factors affecting gene equilibrium.

Lab Outline:

1. Numerical problems

a) Arrangement of genetic material:

i. Linkage and recombination. ii. Gene mapping in diploid. iii. Recombination in Fungi.

iv. Recombination in bacteria. v. Recombination in viruses.

b) Population Genetics:

i. Gene frequencies and equilibrium. ii. Changes in gene frequencies,

2. Blood group and Rh-factor

3. Drosophila i. Culture technique ii. Salivary gland chromosome

4. Fungal Genetics Sacchromyces culture techniques and study.

5. Studies on variation in maize ear size and colour variation

6. Bacterial Genetics.

i. Bacterial cultural techniques, Gram staining (E. coli, B. subtilis) ii. Transformation. ii. Conjugation.

Recommended Books:

1. Gelvin, S, B. 2000. Plant Molecular Biology Manual. Kluwer Academic Publishers.

2. Pierca, B. A. 2005. Genetics. A conceptual approach, W. H. Freeman and Company, New York.

3. Synder, L, and Champness, W. 2004. Molecular Genetics of Bacteria. ASM Press, Washington D. C.

4. Klug, W. S. and Cummings, M. R. 1997. Concepts of Genetics, Prentice Hall International Inc.

5. Roth Well, N. V. 1997. Understanding Genetics, 2 nd Edition, Oxford University Press Inc.

6. Gardner, E. J., 2004. Principles of Genetics, John Willey and Sons, New York.

7. Ringo J, 2004. Fundamental Genetics, Cambridge University Press.

8. Griffiths A. J. F: Wessler, S. R; Lewontin, R. C, Gelbart, W. M; Suzuki, D. T. and Miller, J. H., 2005, Introduction to Genetic Analysis, W. H. Freeman and Company.

9. Snyder, L and Champness W, 2003, Molecular Genetics of Bacteria, ASM Press.

10. Hartl, D. L. and Jones, E. W. 2005, Genetics - Analysis of Genes and Genomes, Jones and Bartlett Publishers. Sudbry, USA.

11. Hedrick, P. W. 2005. Genetics of Population. Jones and Bartlett Publisher, Sudbury, USA.

12. Mahmut Caliskan. 2012. The Molecular basis of plant genetic diversity. In Tech Publishers.

13. Ram J. Singh. 2011. Genetic resources, chromosome engineering and crop improvement. Medicinal plants. Vol. 6. CRC Press.

14. William S. Klug, Michael R. Cummings, Charlotte A. Spencer, Michael A. Palladino. 2011. Concepts of genetics. Pearson Educations.

15. Daniel Hartl. 2011. Genetics Johns and Bartlett Publishers.

16. David Hyde. 2008. Introduction to Genetic principles. McGraw-Hill. 39 17 Daniel, L. Hart, Elizabeth W. Jones. 2009. Analysis of genes and genomes. John and Barlett. 18 Noureddine Benkeblia. 2011. Sustainable agriculture and new biotechnologies. CRC Press.

THIRD YEAR
SIXTH SEMESTER

Course	Pre-Requisite	Course Title	Credit Hrs
BOT-220	Major-V	Plant Biochemistry-I	03 (2+1)

Specific Objectives of course:

To elucidate the structure and role of primary metabolites in plants

Course Outline:

Introduction to photosynthetic organisms, Bioenergetics and overview of photosynthesis, Photosynthesis: The Light Reaction Photosystems, ATP Synthesis, CO 2 Fixation, RuBisCo and enzyme kinetic, C-3 Cycle, C-4 Cycle, Regulation of photosynthesis.

Introduction to carbohydrates: Occurrence and classification, Sugar structures, synthesis of polysaccharides, Carbon metabolism in the chloroplast, Starch synthesis Pentose phosphate pathway Carbon export Sucrose synthesis and transport in vascular plants, Cellulose synthesis and composition of primary cell walls.

Introduction to lipids: Occurrence, classification. Structure and chemical properties of fatty acids, Fatty acid biosynthesis in plants, di and triglycerides, phospholipids, glycolipids, sulpholipids, waxes and sterols.

Introduction to Proteins: Amino acids and their structure. Electro chemical properties and reactions of amino acids. Classification of proteins. Primary, secondary, tertiary and quaternary structure of proteins. Protein targeting. Protein folding and unfolding. Transport, storage, regulatory and receptor proteins. Protein purification. Protein sequencing. Biological role. Plant defense proteins and peptides, Defensins and related proteins, Synthesis and functions of non-ribosomal peptides

Introduction to Nucleic Acids: General introduction. Purine and pyrimidine bases, nucleosides, nucleotides. Structure and properties of DNA and RNA. Types and functions of RNA. Nucleic Acid Metabolism.

Introduction to Enzymes: Nature and functions, I.U.E. classification with examples of typical groups. Isozymes, ribozymes, abzymes. Enzyme specificity. Enzyme kinetics. Nature of active site and mode of action. Allosteric enzymes and feedback mechanism. Enzymes with multiple functions - mechanisms and evolution. Isoprenoid metabolism, Biosynthetic pathways, Monoterpenes, sesquiterpenes, phytosterols, diterpenes, Enzymes with multiple functions - mechanisms and evolution.

Lab Outline:

1. Solutions, acids and bases. Electrolytes, non-electrolytes, buffers, pH. Chemical bonds.
2. To determine the Rf value of monosaccharides on a paper Chromatogram.

3. To estimate the amount of reducing and non-reducing sugars in plant material titrimetrically/spectrophoto metrically.

4. To determine the saponification number of fats.

5. To extract and estimate oil from plant material using soxhlet apparatus.

6. Analysis of various lipids by TLC methods.

7. To estimate soluble proteins by Biuret or Lowry or Dye-binding method.

8. To estimate the amount of total Nitrogen in plant material by Kjeldahl's method.

9. To determine the Rf value of amino acids on a paper chromatogram.

10. Extraction of Nucleic acids from plant material and their estimation by UV absorption or colour reactions.

11. To estimate the catalytic property of enzyme catalase or peroxidase extracted from a plant source. 12. To determine the PKa and isoelectric point of an amino acid.

Recommended Books:

1. Conn E E. and Stumpf P. K., 2002. Outlines of Biochemistry, John Wiley and Sons Inc. New York.

2. Lehninger, A L. 2004. Principles of Biochemistry. Worth Publishers Inc.

3. Voet, D., Voet J. G. and Pratt, C. W. 1998. Fundamentals of Biochemistry, John Wiley and Sons, New York.

4. Dey, P. M. and Harborne, J. B. 1997. Plant Biochemistry. Harcourt Asia PTE Ltd. Singapore.

5. Smith, E. L, Hill, R L, Lehman, R I., Lefkowits, R J. Handler and Abraham. 2003, Principles of Biochemistry, (General Aspects). White. International Student Edition. McGraw Hill International Book Company.

6. Zubay G,.2003, Biochemistry, MacMillan Publishing Co., New York.

7. Chesworth,.J. M., Strichbury T. and Scaife., J. R. 1998. An introduction to agricultural biochemistry. Chapman and Hall, London.

8. Mckee, T. and Mckee, J. R. 1999. Biochemistry – An Introduction. WCB/McGraw-Hill, New York, Boston, USA.

9. Lea, P. J.. and Leegood, R. C. 1993. Plant Biochemistry and Molecular Biology. Wiley and Sons, New York. 10. Abdes, R. H. Frey, P. A. and Jencks W. P. 2004, Biochemistry, Jones and Bartlet, London.

11. Goodwin T. W. and Mercer, E. I. 1997. Introduction to Plant Biochemistry. Pergamon Press, Oxford.

12. Heldt, H. W. 2008. Plant Biochemistry. 3rd Edition, Academic Press, U. K.

13. Bowsher, C. 2008. Plant Biochemistry. 14. Campbell, M. K. and F. Shawn. 2008. Biochemistry 6th

Edition. Journals / Periodicals: Plant Physiology and Biochemistry, Annual Review of Biochemistry, Biochemistry Journal, Critical Review in Biochemistry and Molecular Biology

Course Code	Pre-Requisite	Course Title	Credit Hrs
BOT-221	Foundation-IX	Plant Ecology-I	03 (2+1)

Specific Objectives of course:

To understand the role and interaction of plants with their environment

Course Outline:

1. Introduction: history and recent developments in ecology
2. Soil: Nature and properties of soil (Physical and Chemical). Water in the soil- plant-atmosphere continuum. The ionic environment and plant ionic relations, Nutrient cycling. Physiology and ecology of N, S, P and K nutrition. Heavy metals (brief description), Salt and drought stress and osmoregulation. Soil erosion
3. Light and temperature: Nature of light, Factors affecting the variation in light and temperature, Responses of plants to light and temperature, Adaptation to temperature extremes,
4. Carbon dioxide: Stomatal responses, water loss and CO2-assimilation rates of plants in contrasting environments. Ecophysiological effects of changing atmospheric CO2 concentration. Functional significance of different pathways of CO2 fixation. Productivity: response of photosynthesis to environmental factors, C and N balance
5. Water: Water as an environmental factor, Role of water in the growth, adaptation and distribution of plants, Water status in soil, Water and stomatal regulation, Transpiration of leaves and canopies.
6. Oxygen deficiency: Energy metabolism of plants under oxygen deficiency, Morpho-anatomical changes during oxygen deficiency, Post-anoxic stress
7. Wind as an ecological factor.
8. Fire as an ecological factor.

Lab Outline:

1. Determination of physico-chemical properties of soil and water.
2. Measurements of light and temperature under different ecological conditions.
3. Measurements of wind velocity.
4. Measurement of CO2 and O2 concentration of air and water.
5. Effect of light, temperature, moisture, salinity and soil type on germination and growth of plants.
6. Measurement of ions, stomatal conductance, osmotic potential, water potential, xylem. pressure potential, leaf area and rate of CO2 exchange in plants in relation to various environmental conditions.

Recommended Books:

1. M. Ahmad and S. S. Shaukat. 2012. A test book of vegetation ecology. Publisher Abrar Sons New Urdu Bazar Karachi.

2. Schultz, J. C. 2005. Plant Ecology, Springer-Verlag

3. Bazzaz, F. A. 2004. Plants in Changing Environments: Linking Physiological, Population, and Community Ecology, Cambridge University Press

4. Chapin, F. S. et al. 2002. Principle of Terrestrial Plant Ecology, Springer- Verlag

5. Lambers, H. et al. 2002. Plant Physiological Ecology, Springer-Verlag

6. Larcher, W. 2003., Physiological Plant Ecology: Ecophysiology and Stress Physiology of Function Groups - Springer-Verlag

7. Nobel, P. S 1999, Physico-chemical and Environmental Plant Physiology, Academic Press.

8. Lambers, H., T. L. Pons and F. Stuart. 2008. Plant Phyiological Ecology.

9. Smith, R. L. 2004. Ecology and field Biology. Addison Wesley Longman, Inc., New York.

10. Barbour, M. G., Burke, J. H and Pitts, W. D. 2004 Terrestrial Plant Ecology, The Benjamin, Cumming Publishing C. Palo Alto, California, USA.

11. Smith R. L. 1998 Elements of Ecology. Harper & Row Publishing.

12. Townsend. C. R. Begon. M and J. L Harper. 2002 Essentials of ecology. Blackwell Publishing.

13. Gurevitch. J. Scheiner, S. M. and G. A Fox. 2006 The Ecology of Plants\. Sinaur Associate Inc.

14. Hussain. F. 1989 Field and Laboratory Manual of Plant Ecology, National Academy of Higher Education, Islamabad.

15. Hussain. S. S. 1989 Pakistan Manual of Plant Ecology. National Book Foundation Islamabad.

16. More. P. D. and Chapman S. B. 1986 Methods in Plant Ecology, Blackwell Scientific Publication Oxford. 17. Rashid, A. 2005. Soil Science. National Book Foundation, Islamabad.

Journals / Periodicals: Pakistan Journal of Botany, Journal of Ecology, Journal of Applied Ecology, Ecology, Journal of Arid Environment

Course	Pre-Requisite	Course Title	Credit Hrs
BOT-222	Major-VI	Plant Physiology-I	03 (2+1)

Specific Objectives of course:

To provide comprehensive knowledge on some vital functions and mechanisms of plants.

Course Outline:

1. Photosynthesis: History of photosynthesis. Nature and units of light. Determination of oxygenic and anoxygenic photosynthesis. Ultrastructure of thylakoid vesicle. Various pigments and photosynthetic activity. Ultrastructure and composition of photosystem-I and II. Absorption and action spectra of different pigments. Mechanism of photosynthesis - light absorption, charge separation or oxidation of water (water oxidizing clock), electron and proton transport through thylakoid protein-pigment complexes. Photophosphorylation and its mechanism. CO2 reduction (dark reactions) - C3 pathway and Photorespiration, Regulation of C3 pathway, C4 pathway and its different forms, C3-C4 intermediates, CAM pathway. Methods of measurement of photosynthesis.

2. Respiration: Synthesis of hexose sugars from reserve carbohydrates. Mechanism of respiration-Glycolysis, Differences between cytosolic and chloroplastidic glycolysis, Oxidative decarboxylation, Krebs cycle, Regulation of glycolysis and Krebs cycle, Electron transport and oxidative phosphorylation. Aerobic and anaerobic respiration. Energetics of respiration. Pentose phosphate pathway. Glyoxylate cycle. Cyanide resistant respiration.

3. Translocation of Food: Pathway of translocation, source and sink interaction, materials translocated, mechanism of phloem transport, loading and unloading.

4. Leaves and Atmosphere: Gaseous exchange, mechanism of stomatal regulation. Factors affecting stomatal regulation. 5. Assimilation of Nitrogen, Sulphur and Phosphorus: The nitrogen cycle. Nitrogen fixation. Pathways of assimilation of nitrate and ammonium ions. Assimilation of sulphur and phosphorus.

Lab Outline:

1. To determine the volume of CO2 evolved during respiration by plant material.

2. To determine the amount of O2 used by respiring water plant by Winkler Method.

3. Separation of chloroplast pigments on column chromatogram and their quantification by spectrophotometer.

4. To extract and separate anthocyanins and other phenolic pigments from plant material and study their light absorption properties. 5. To categorize C3 and C4 plants through their anatomical and physiological characters. 6. To regulate stomatal opening by light of different colours and pH.

Recommended Books:

1. Dennis, D.T., Turpin, D.H., Lefebvre, D.D. and Layzell, D.B. 1997. Plant Metabolism. 2nd Edition. Longman Group, U.K.

2. Dey, P.M. and Harborne, J.B. 1997. Plant Biochemistry. Harcourt Asia PTE Ltd. Singapore.

3. Fitter, A. and Hay, R.K.M. 2001. Environmental Physiology of Plants. Academic Press, UK.

4. Heldt, H-W. 2004. Plant Biochemistry. 3rd Edition, Academic Press, U.K.

5. Ihsan Illahi, 1991. Plant Growth, UGC Press, Islamabad.

6. Ihsan Illahi, 1995. Plant Physiology, Biochemical Processes in Plants, UGC Press.

7. Nobel, P.S. 1999. Physicochemical and Environmental Plant Physiology. Academic Press, UK.

8. Press, M.C., Barker, M.G., and Scholes, J.D. 2000. Physiological Plant Ecology, British Ecological Society Symposium, Volume 39, Blackwell Science, UK.

9. Salisbury F.B. and Ross C.B. 1992. Plant Physiology. 5th Edition. Wadsworth Publishing Co. Belmont CA. 10. Taiz, L. and Zeiger, E. 2006. Plant Physiology. 4th Edition. Sinnauers Publ. Co. Inc. Calif.

11. W.B. Hopkins. 1999. Introduction to Plant Physiology. 2nd Ed. John Wiley and Sons. New York.

12. Epstein, E. and Bloom, A.J. 2004. Mineral Nutrition of Plants: Principles and Perspectives. 2nd Edition. Sinauer Associates, California, USA.

13. Kirkham, M.B. 2004. Principles of Soil and Plant Water Relations. Elsevier, Amsterdam, Netherlands.

14. Barton, W. 2007. Recent Advances in Plant Physiology.

Journals/Periodicals: Pakistan Journal of Botany, Plant Physiology, Physiologia Plantarum, lanta, Annual Review of Plant Biology, Journal of Plant Physiology.

Course	Pre-Requisite	Course Title	Credit Hrs
BOT-223	Major-VII	Molecular Biology	03 (2+1)

Specific Objectives of course:

To disseminate the knowledge of molecular basis of life

Course Outline:

1. Nucleic Acids: DNA-circular and superhelical DNA. Renaturation, hybridization, sequencing of nucleic acids, synthesis of DNA, Central Dogma

2. Proteins: Basic features of protein molecules. Folding of polypeptide chain, α- helical and β-secondary structures. Protein purification and sequencing.

3. Transcription: Enzymatic synthesis of RNA, transcriptional signals Translation: The genetic code. The Wobbling, polycistronic and monocistronic RNA. Overlapping genes.

4. Gene regulation in Eukaryotes: Differences in genetic organization and prokaryotes and eukaryotes. Regulation of transcription, initiation, regulation of RNA processing, regulation of nucleocytoplasmic mRNA transport, regulation of mRNA stability, regulation of translation, regulation of protein activity.

5. Plant Omics: Transcriptomics; DNA libraries, their construction, screening and application. Microarray of gene technology and its application in functional genomics.

6. Proteomics; structural and functional proteomics. Methods to study proteomics Metabolomics; methods to study metabolomics; importance and application of metabolomics

7. Bioinformatics and computational biology. Levels, scope, potential and industrial application of bioinformatics and computational biology, Docking.

Lab Outline:

Following techniques will be used for the isolation and analysis of different components:

1. Extraction of RNA, DNA and proteins
2. Electrophoreses: One and two dimensional
3. Purification of proteins, RNA and DNA.
4. Amplification using PCR. 5. Northern, Western and Southern Blotting.

Recommended Books:

1. Cullis, C. A. 2004. Plant Genomics and Proteomics. Wiley-Liss, New York.
2. Gibson, G. and S. V. Muse, 2002. A Premier of Genome Science, Sinauer Associates Inc. Massachusetts.

3. Gilmartin, P. M. and C. Bowler. 2002. Molecular Plant Biology. Vol. 1 & 2. Oxford University Press, UK. 4. Lodish, H. et al., 2004. Molecular Cell Biology. 5th Edition. W. H. Freeman & Co., New York.

5. Malacinski, G. M. 2003. Essentials of Molecular Biology, 4th Edition. Jones and Bartlett Publishers, Massachusetts.

6. Watson, J. D. et al. 2004. Molecular Biology of the Gene. Peason Education, Singapore.

7. Ignacimuthu, S. 2005. Basic bioinformatics. Narosa Publishing House, India.

8. Weaver, R. F. 2005. Molecular Biology. McGraw-Hill, St. Louis.

9. Lehninger, A L. 2004. Principles of Biochemistry. Worth Publishers Inc.

10. David Figurski. 2013. Genetic manipulation of DNA and protein, example fromcurrent research. In Tech Publishers.

11. Bruce Alberts et al. 2007. Molecular biology of the cell. 5th Edition. Garland and Sons.

12. M. Madan Babu. 2013. Bacterial gene regulations and transcription network. Caister Publishers. Academic Publishers.

Course	Pre-Requisite	Course Title	Credit Hrs
BOT-224	MAJOR-VII	Phytogeography	03 (2+1)

Specific Objectives of course:

To understand the geographical region of plants.

Course Outline:

Introduction to phytogeography, Principles/ generalizations of phytogeography.Terms and concept of Introduction to phytogeography, Principles/ generalizations of phytogeography.Terms and concept of area.Concept of region.Phytogeographical regions with special emphasis on Pakistan.Numerical analysis of flora of Pakistan. Concept of endemism, types of endemism, endemism in Flora of Pakistan, Role of endemism in Systematics. Flora of the past, migration and the evolution of the vegetation.Dispersal strategies.Geological history and past distribution of flowering plants.Discontinuous or disjunct distribution, classification of international disjunction. Centre of area. Ecological distribution of centers of major adaptive radiations in angiosperms.

Lab outline

1. To study the variation pattern found in the same species collected from different localities with the help of scattered diagram and polygraph.
2. To study the distribution pattern of the given taxa and their status with respect to their presence in different geographical regions.
3. To determine the status of the given endemic taxa.
4. To study the different leaf size classes of wild species growing in the vicinity of University.
5. To study the different leaf size classes of cultivated species growing in the vicinity of University.
6. At least one field trip to study the topography and vegetation of any one or two phytogeographical regions.
7. Report of field trip.

Recommended Books:

1. Armen L. Takhtajan. 1988. Floristic regions of the world. The University of California Press. Berkeley and Los Angeles, U. S. A.
2. Plant Geography by Anil K. Charan. Published by Rawat Published, 1992.
3. Plant Geography by Martin C. Kellman, Edition: 2. Published by Routlege, 1980. ISBN 0416738605, 9780416738605.

4. Taxonomy, Phytogeography and Evolution by D. H. Valentine. Published by Academic Press, 1972. ISBN 0012712507, 9780012712504.
5. Ecology and phytogeography of high altitude plants of the northwest Himalaya: introduction to high altitude Botany by M. S. Mani. Published by Chapman and Hall, 1978.
6. Historical Plant Geography: an Introduction by Philip Anthony Stott. Published by Allen &Unwin, 1981. ISBN 0045800103, 9780045800100.
7. Contributions to Botany: Studies in Plant Geography, Phylogeny and Evolution, Ethnobotany and Dendrological and Horticultural Botany by Hui-Lin Li. Published by Epoch Pub. Co., 1982.
8. A text book of the Plant Geography of India by F. R. Bharucha, Bharucha. Published by Oxford University Press, 1983.

SEMESTER SEVEN
FOURTH YEAR

Course Code	Pre-Requisite	Course Title	Credit Hrs
BOT-310	Major-VIII	Plant Biochemistry-II	03 (2+1)

Specific Objectives of course:

To explicit the fundamentals of metabolic energy, Metabolism and Plant constituents.

Course Outline:

1. Bioenergetics: Energy, laws about energy changes. Oxidation and reduction in living systems.
2. Metabolism:

i. Biosynthesis, degradation and regulation of sucrose and starch. Breakdown of fats with special reference to beta-oxidation and its energy balance. Biosynthesis of fats.

ii. Replication of DNA. Reverse transcription. Biosynthesis of DNA and RNA.

iii. Components of protein synthesis. Genetic code, protein synthesis: initiation, elongation and termination.

3. Alkaloids: Occurrence, physiological effects, chemical nature with special reference to solanine, nicotine, morphine, theine and caffeine. Aflatoxins, their nature and role.
4. Terpenoids: Classification: monoterpenes, sesquiterpenes, diterpenes, triterpenes, tetraterpenes, polyterpenes and their chemical constitution and biosynthesis.
5. Vitamins: General properties and role in metabolism.

Lab Outline:

1. Separation of soluble proteins by polyacrylamide gel (PAGE) electrophoresis.
2. Separation of nucleic acids by gel electrophoresis.

3. To estimate the amount of vitamin C in a plant organ (orange, apple juice).

4. To determine potential alkaloids in plants.

5. To estimate terpenoids in plants.

Recommended Books:

1. Conn E. E. and Stumpf, P. K. 2002. Outlines of Biochemistry, John Wiley and Sons Inc. New York.

2. Albert L. Lehninger, 2004. Principles of Biochemistry. Worth Publishers Inc.

3. Voet, D. Voet J. G. and Pratt, C. W. 1998. Fundamentals of Biochemistry, John Wiley and Sons, New York.

4. Dey, P. M. and Harborne, J. B. 1997. Plant Biochemistry. Harcourt Asia PTE Ltd. Singapore.

5. Smith; E L., Hill; R. L., Lehman; R. I., Lefkowits, R J. and Abraham. H. Principles of Biochemistry, (General Aspects). White. International Student Edition. McGraw Hill International Book Company.

6. Zubay. G. 2003, Biochemistry, MacMillan Publishing Co., New York.

7. Chesworth,. J. M., Strichbury T. and Scaife, J. R. 1998. An introduction to Agricultural Biochemistry. Chapman and Hall, London.

8. Mckee, T. and Mckee, J. R. 1999. Biochemistry – An Introduction. WCB / McGraw-Hill, New York, Boston, USA.

9. Taiz, L. and Zeiger, E. 2006. Plant Physiology. 4th Edition. Sinnauers Publ. Co. Inc. Calif.

10. Lea, P. J. and Leegood, R. C. 1993. Plant Biochemistry and Molecular Biology. Wiley and Sons, New York.

11. Abides, R. H., Frey P. A. and Jencks, W. P. 1992. Biochemistry, Jones and Bartlet, London.

12. Goodwin T. W. and Mercer, E. I. 1997. Introduction to Plant Biochemistry. Pergamon Press, Oxford.

13. Heldt, H. W. 2008. Plant Biochemistry. 3rd Edition, Academic Press, U. K.

14. Campbell, M.K. and F. Shawn. 2008. Biochemistry 6th Edition.

Journals / Periodicals: Plant Physiology & Biochemistry, Annual Review of Biochemistry, Biochemistry Journal, Critical Review in Biochemistry and Molecular Biology

Course	Pre-Requisite	Course Title	Credit Hrs
BOT-311	Major-IX	Plant Ecology-II	03 (2+1)

Specific Objectives of Course:

To provide comprehensive knowledge of population, community, ecosystem ecology and its relevance to mankind.

Course Outline:

A. Population Ecology

1 Population structure and plant demography: Seed dispersal, Dormancy, Seed Bank, Seed dormancy, Recruitment, Demography

2. Life history pattern and resource allocation : Density dependent and density independent factors, Resource allocation, Reproductive effort, Seed size vs seed weight, Population genetics, Evolution

B. Community Ecology:

Historical development of community ecology, Community concepts and attributes, Methods of sampling of plant communities, Ecological succession, Community soil-relationship, Local Vegetation, Vegetation of Pakistan, Major formation types of the world

C. Ecosystem Ecology:

Ecological concepts of ecosystem, Boundaries of ecosystem. Compartmentalization and system concepts, Energy flow in ecosystem, Biogeochemical cycles: water carbon and nitrogen Case studies.

Lab Outline:

Determination of seed bank in various populations. Seed dispersal pattern of local populations. Demography and life history of local annual population. Study of community attributes. Sampling of vegetation including Quadrat, plotless, transect and Braun-Blanqut. Correlate soil properties with vegetation type. Field trip to study different communities located in different ecological regions of Pakistan. Slide show of the vegetation of Pakistan. Slide show of the major formations of the world. Soil physical and chemical properties.

Recommended Books:

1. Ahmad, M. and S. S. Shaukat. 2012. A test book of vegetation ecology. Publisher Abrar Sons, New Urdu Bazar, Karachi.

2. Schultz J. C. 2005. Plant Ecology, Springer-Verlag.

3. Townsend C. R. Begon. M and J. L. Harper 2002. Essentials of Ecology, Blackwell Publishing,

4. Chapin, F.S. et al. 2002. Principle of Terrestrial Plant Ecology, Springer-Verlag

5. Gurevitch, et al., 2002.The Ecology of Plants, Sinauer Associates, Inc.

6. Barbour M. G. et al., 1999, Terrestrial Plant Ecology, The Benjamin-Cumming Publishing Co.

7. Smith, R. L. 1998. Elements of Ecology by Harper & Row Publishers,

8. Moore P.D. and Chapman S. B. 1986. Methods in Plant Ecology, Blackwell Scientific Publication, Oxford. 9. Hussain, S. Pakistan Manual of Plant Ecology,

10. Hussain, F. 1989. Field and Laboratory Manual of Plant Ecology, National Academy of Higher Education. Islamabad

11. Lambers, H., T. L. Pons and F. Stuart. 2008. Plant Physiological Ecology.

12. Larcher. W. 2003 Physiological Plant Ecology. Ecophysiology and Stress Physiology of Function Groups. Springer- Verlag. Journals/Periodicals: Ecology, Journal of Ecology, Journal of Applied Ecology

Course	Pre-Requisite	Course Title	Credit Hrs
BOT-312	MAJOR-X	Research Methodology	03 (2+1)

Course Outline Introduction:

Definition, the purpose of research, kinds of research Format of thesis/ Dissertation: Differences between of thesis and Dissertation. Parts of thesis/ dissertation. Writing synopsis or research proposal.

How to write thesis or Dissertation: Preliminary pages, Pretext pages: Title page, approval page, List of table, List of figures etc. Main body of thesis/ dissertation: Title, abstract, introduction, material and methods, results, discussion (or results and discussion), conclusions, recommendations, acknowledgements, references, tables, figures, photos, appendices. Submission of thesis/ dissertation. Pagination of preliminary pages and main body of thesis/ dissertation.

Review of Literature: How to collect the relevant literature, how to extract the desired information, how to write in our own wards? Citing of references in text and at the end: Different styles of writing references in the text. Different styles for wring complete references at the end under Cited References. Different options for formats such as Name-year system, Number sequence system or Number alphabetical list system.

Writing correct scientific names: Binomial nomenclature, writing generic, specific names, authority citatation, variety, cultivars, subspecies, and forma.Names above the generic level, names below the specific level.

Writing and submission of research paper: Parts of research paper, raw material, first, 2nd and 3rd draft, final draft. Submission to the suitable journal.

Writing reports: What is a report and parts of report? Submission of report.

Writing Lab Report: Parts of lab report and its submission.

Publication ethics: Duplication, authorship, copyright, permission to use other source, honesty.

Course	Pre-Requisite	Course Title	Credit Hrs
BOT-313		Elective-iii/Research Project / Internship/Optional paper (Optional paper: Medicinal Plants (Pharmacognosy)	03 (2+1)

Specific Objectives of course:

To provide comprehensive knowledge about the medicinal plants and their ecology and chemistry.

Course Outline

Introduction:

Definition and historical background: Definition of pharmacognosy, drug, crude drug, official and unofficial drugs. Cultivation etc. Cultivation, collection, curing, drying, preservation. Drug: Evaluation, classification of drugs and Therpeutic classes.

Detailed study:

Detail study of the following medicinal plants including valid scientific, synonyms, local names, botanical origin, distribution of plants, method of cultivation, macroscopic and microscopic characteristics of the drugs (histology and powdered drug of the part used). Chemical constituents, uses and adulterants with special reference Ethnopharmacognosy of the medicinal plants.

Gymnosperms

Ephedra (Ephedra Sp.) Ephedraceae.

Angiosperms

Dicotyledons

a. Roots/Rhizomes/Corm/bulbs

1. Root of Aconite: Aconitum napellus(Family Ranunculaceae).
2. Rhizome of Mandrake: Podophyllumpeltatum(FamilyPodophyllaceae).
3. Rhizome of Liquorice: Glycyrrrizaglabra (Family Papilonaceae).
4. Root bark of Berberis:Berberis lyceum (Family Berberidaceae). Moncotyledons
5. Corm of Colchicum: Colchicum autumnale (Family Colchicaceae).
6. Rhizome of Zingiber: Zingiberofficinale (Family Zingibaeraceae).

b. Leaves

7. Leaves of Peppermint:Menthapiperita (Family Lamiaceae).
8. Leaves of Thyme: Thymus Specie (FamilyLamiaceae).
9. Leaves of Atropa: Atropabelladomna (Family Solanaceae).
10. Leaves ofStramonium: Daturastramonium (Family Solanaceae).
11. Leaves of Henbane: Hycocyamusniger(Family Solanceae).

12. Leaves of Foxglove: Kigitalespurpurea (Family Scorphulariaceae).

13. Leaves of Euclyptus: Euclyptusspp, (Family Myrataceae).

c. Flowers/Florets

14. Flower of Clove: Syzygiumaromaticum (Family Myrtaceae).

15. Florets of Santonica: Artemisia kurramensis(Family Asteraceae).

16. Florets of Calendula: Calendula officinalis (FamilyAsteraceae).

17. Florets of Tarraxacum: Tarraxacumofficinale (Family Asteraceae).

18. Florets of Carthamus: Carthamustinctorius (Family Asteraceae).

19. Florets ofGentiana: Gentianalutea (Family Gentianaceae).

d. Fruits/Seeds

20. Fruits of Cassia: Cassia fistula (Family Caesalpinaceae).

21. Fruits of Fennel:Foeniculum vulgare (Family Apiaceae).

22. Seeds of Linum: Linumusitatissumum(Family Linaceae).

e. Others

23. Opium: Papaver somniferum (Family Papaveraceae).

24. Gum of acacia: Acacia Senegal (Family Mimosaceae).

f. Fungi

25. Ergot: Clavicepspurpurea(Family Cavicipitaceae).

Recommended Books

1. Tyler, V.E.L.R. Brady and E.P. Clayse. 1970. Pharmacognosy. 6th Ed. Leimption London
2. Trease, G.E. and W. C. Evans. 1985. Pharmacognosy. 12 th Ed. English Language Soc. Baillere Tindall.
3. Wallis, T.E. 1981. A Textbook of Pharmacognosy. J. & A. Churchill Ltd. Glousester Palace, W.I. London. 4. Youngkin, H.W. 1950. A Textbook of Pharmacognosy. The Blackistasn Co. Toronto Philadelphia.
5. Jackson, B.P. and D.W. Snowdon 1992. Atlas of microscopy of medicinal plants. Culinary herbs and spices. Nazia printer Delhi India.
6. Said, H.M., 1996. Medicinal Herbal Vol. 1, Hamdard Foundation. Pakistan.

Course	Pre-Requisite	Course Title	Credit Hrs
BOT-314		ELECTIVE-II (Plant pathology)	

Specific Objectives of course:

To introduce the students to Pathology and Diseases caused by Fungi virus, Bacteria and nematodes in plants.

Course Outline

History: History of plant pathology, Concept of Plant Pathology, symptoms, classification of symptoms, causes of plant diseases, disease, relationship, and establishment Nature and classification of plant pathogens.

Epidemeology of diseases.

Dispersal of pathogens.

Physiology of Parasitism.

Pre-penetration, penetration and post- penetration, general methods of plant disease control and principles, Biochemical basis of disease resistance. Phytoalexins, elicitors and plant disease protection.

Control of Plant diseases; Exclusion, eradication, protection, breeding resistant varieties, Major types of fungicides. Influence of environmental factors on plant diseases; General account of non-parasitic diseases.

Important diseases: Important diseases of crops, plants and fruit trees in Pakistan such as Damping off (Crucifers, tomatoes). Loose Smut (wheat).Covered smut of wheat; Black stem rust. Yellow stripe rust of wheat, Apple scab. Peach leaf curl; Late blight of potatoes. Red rot of sugarcane. Bacterial wilt of cucurbits, Tobacco Mosaic disease.

Lab Outline

1. Identification of major plant pathogens under lab and field conditions, cultural studies of some important plant pathogenic fungi, application of Koch's postulates for confirmation of pathogenicity. Demonstration of control measures through chemotherapeutants.
2. Basic plant pathological culture techniques
3. Pathogenicity of a pathogen
4. Effects of fungicides on spore germination
5. Macroscopic and microscopic examination of diseases specimens of the types studied.
6. Growth of aerial contaminants in culture
7. Isolation of pathogenic fungi from soil waters and air
8. Candidates will submit a collection of 20 properly preserved fungi or diseased specimen.

Recommended Books

1. Agrios, G.N., 2005. Plant Pathology, Academic Press, London.
2. Ahmad, I. and Bhutta, A.R., 2004. Textbook of Introductory Plant Pathology. Book Foundation, Pakistan.
3. Alexopoulos, C.J., Mims, C.W. and M. Blackwell. 1996. Introductory Mycology. 4th ed. John Wiley & Sons.
4. Khan, A.G. and R. Usman. 2005. Laboratory Manual in Mycology and Plant Pathology. Botany Department Arid Agriculture University, Rawalpindi.
5. Moore-Landecker, E. 1996. Fundamentals of Fungi. 4th ed. Prentice Hall Inc., New Jersey, USA.
6. Trigiano, R.N., Windham, M.T. and Windham, A.S., 2004. Plant Pathology: Concepts and Laboratory Exercises. CRC Press, LLC, N.Y.

EIGHT SEMESTER
FOURTH YEAR

Course Code	Pre-Requisite	Course Title	Credit Hrs
BOT-320	Major-X	Plant Physiology-II	03 (2+1)

Specific Objectives of course:

To give it comprehensive and advance knowledge of growth regulators, mechanism of water uptake and role of essential nutrients in plant metabolism

Course Outline:

1. Plant Growth Regulators: Major natural hormones and their synthetic analogues. Bioassay, structure, biosynthesis, receptors, signal trasduction and mode of action, transport, physiological effects of Auxins , Gibberellins, Cytokinins, Abscisic acid, Ethylene, Polyamines, Brassinosteriods, Jasmonates, and Salicylic acid.
2. Water Relations: The soil -plant -atmosphere continuum - an overview. Structure of water. Physico-chemical properties of water. Water in the soil and its potentials. Water in cell components. Absorption of water in plants (pathways and driving forces, Aquaporins,-their structure and types). Cell water relations terminology. Hofler diagram - analysis of change in turgor, water and osmotic potential with changes in cell volume. Modulus of elasticity coefficient; Hydraulic conductivity. Osmoregulation, Methods for measurement of water , osmotic and turgor potentials- Pressure chamber, psychrometry, pressure probe, pressure volume curve.
3. Plant Mineral Nutrition: Inorganic composition of plant and soil. Absorption of mineral nutrients - roots, mycorrhizae. Effect of soil pH on nutrient availability. Ion traffic into root. The nature of membrane carriers, channels and electrogenic pumps. Passive and active (primary and secondary) transports and their energetics. Essential and beneficial elements-their functions and deficiency symptoms in plants. Fertilizers and their significance in Agriculture.

4. Phytochromes: Discovery of phytochromes and cryptochromes. Physical and chemical properties of phytochromes. Distribution of phytochromes among species, cells and tissues and their role in biological processes. Phytochromes and gene expression.
5. Control of Flowering: Autonomous versus environmental regulation. Circadien rhythms. Classification of plants according to photoperiodic reaction, photoperiodic induction, locus of photoperiodic reaction and dark periods in photoperiodism. Role of photoperiodism in flowering. Biochemical signaling involved in flowering. Vernalization and its effect on flowering. Floral meristemand floral organ development. Floral organ identity genes and the ABC model.
6. Signal transduction in prokaryotes and eukaryotes.
7. Dormancy; definition and causes of seed dormancy; methods of breaking seed dormancy; types and physiological process of seed germination.
8. Plant Movements; Tropic movement-phototropism, gravitropism and their mechanism. Nastic movements.

Lab Outline:

1. To investigate the preferential absorption of ions by corn seedlings and potato slices.
2. To determine osmotic potential of massive tissue by freezing point depression method or by an osmometer.
3. To investigate water potential of a plant tissue by dye method and water potential apparatus.
4. Determination of K uptake by excised roots.
5. Measurement of stomatal index and conductance.
6. Qualitative determination of K content in Guard cells by Sodium cobalt nitrite method.

Recommended Books:

1. Dennis, D. T., Turpin, D. H., Lefebvre, D. D. and Layzell, D. B. 1997. Plant Metabolism. 2nd Edition. Longman Group, U. K. Dey, P. M. and Harborne, J. B. 1997. Plant Biochemistry. Harcourt Asia PTE Ltd. Singapore.
2. Fitter, A. and Hay, R. K. M. 2001. Environmental Physiology of Plants. Academic Press, UK.
3. Heldt, H. W. 2004. Plant Biochemistry. 3rd Edition, Academic Press, U.K.
4. Ihsan Illahi, 1991. Plant Growth, UGC Press, Islamabad.
5. Ihsan Illahi, 1995. Plant Physiology, Biochemical Processes in Plants, UGC Press.
6. Nobel, P. S. 1999. Physicochemical and Environmental Plant Physiology. Academic Press, UK.
7. Press, M. C., Barker, M. G., and Scholes, J. D. 2000. Physiological Plant Ecology, British Ecological Society Symposium, Volume 39, Blackwell Science, UK.

8. Salisbury F. B. and Ross C. B. 1992. Plant Physiology. 5th Edition. Wadsworth Publishing Co. Belmont CA.
9. W. B. Hopkins. 1999. Introduction to Plant Physiology. 2nd Ed. John Wiley and Sons. New York.
10. Epstein, E. and Bloom, A. J. 2004. Mineral Nutrition of Plants: Principles and Perspectives. 2nd Edition. Sinauer Associates, California, USA.
11. Kirkham, M. B. 2004. Principles of Soil and Plant Water Relations. Elsevier, Amsterdam, Netherlands.
12. Barton, W. 2007. Recent Advances in Plant Physiology. 15. Taiz, L. and Zeiger, E. 2006. Plant Physiology. 4th Edition. Sinnauers Publ. Co. Inc. Calif.

Journals / Periodicals:

Pakistan Journal of Botany, Plant Physiology, Physiologia Plantarum, Planta, Annual Review of Plant Biology, Journal of Plant Physiology.

Course	Pre-Requisite	Course Title	Credit Hrs
BOT-321	Major-XI	Genetics-II	03 (2+1)

Specific Objectives of Course:

To introduce students recombination of genetic material at molecular levels with emphasis on introduction to biotechnology and genomics.

Course Outline:

1. Recombinant DNA: Recombinant DNA Technology Introduction, Basic Techniques, PCR and Rt PCR, Restriction enzymes, Plasmids, Bacteriophages as tools, the formation of recombinant DNA, recombinant DNA methodology, Site directed Mutagenesis, DNA sequencing.
2. Application of Recombinant DNA: Applications of recombinant DNA technology using prokaryotes, recombinant DNA technology in eukaryotes: An overview, transgenic yeast, transgenic plants, transgenic animals, screening for genetic diseases, identifying disease genes, DNA typing, gene therapy, genetically modified organisms and apprehensions.
3. Mechanisms of Genetic Change I: Gene Mutation: The molecular basis of gene mutations, spontaneous mutations, induced mutations, reversion analysis mutagens and carcinogens, biological repair mechanisms.
4. Mechanisms of Genetic Change II: Recombination: General homologous recombination, the holiday model, enzymatic mechanism of recombination, site-specific recombination, recombination and chromosomal rearrangements.
5. Mechanisms of Genetic Change III: Transposable Genetic Elements: Insertion sequences, transposons, rearrangements mediated by transposable elements, review of transposable elements in prokaryotes, controlling elements in maize.

6. Human Genome Project: Strategies and application, achievement and future prospects.

7. Plant Genome Projects: Arabidopsis, achievement and future prospects. Other plant genome projects 8. Bioinformatics: Application of computational tests to the analysis of genome and their gene products 9. Bioethics: Moral, Religious and ethical concerns.

Lab Outline:

Problems relating to the theory

1 Isolation and separation of DNA and protein on Gel electrophoresis.

i. Bacterial chromosome
ii. Plasmid DNA (minipreps)
iii. Plant DNA iv. Protein

2 DNA Amplification by PCR

Recommended Books:

1. Trun, N and Trempy J. 2004, Fundamental Bacterial Genetics, Blackwell Publishing House.

2. Winnacker, E. L.2003, From Gene to Clones Introduction to Gene Technology, Panima Publishing Corporation, New Delhi.

3. Beaycgamp T. L. and Walters L., Contemporary Issues in Bioethics, Wadsworth Publishing Company.

4. Brown, T. A. 2002 Genomes, Bios Scientific Publishers Ltd.

5. The Genome of Homo Sapiens, 2003, Cold Spring Harbor Laboratory Press.

6. Ignacimuthu, S. 2005, Basic Bioinformatics, Narosa Publishing House, India,.

7. Lwein, B. 2004, Gene VIII, Pearson Education Int.

8. Miglani, 2003, Advanced Genetics, Narosa Publishing House, India,.

9. Hartt, D. L, and Jones, E. W. 2005. Genetics, Analysis of Gene and Genomes. Jones and Bartlett Publishers, Sudbury, USA

10. Gelvin, S. B. 2000. Plant Molecular Biology Manual. Kluwer Academic Publishers.

11. Primrose, S. B., Twyman, R. M. and Old R. W. 2004. Principles of Gene Manipulation, an Introduction to Genetic Engineering (6th Edition), Blackwell Scientific Publications.

12. Snyder, L and Champness W, 2003, Molecular Genetics of Bacteria, ASMPress.

13. Wilson, J. and Hunt, T. 2004. Molecular Biology of the cell – the problems book, Garland publishing Inc.

14. Anthony J. F Griffiths, Jeffrey H Miller, David T Suzuki, Richard C Lewontin, and William M Gelbart. W. H. 2009. An Introduction to Genetic Analysis, 7th Edition. Freeman and Company.

15. Hedrick, P. W. 2005. Genetics of Population. Jones and Bartlett Publisher, Sudbury, USA.

16. Mahmut Caliskan. 2012. The Molecular basis of plant genetic diversity. In Tech Publishers.

17. Ram J. Singh. 2011. Genetic resources, chromosome engineering and crop improvement. Medicinal plants. Vol. 6. CRC Press.
18. William S. Klug, Michael R. Cummings, Charlotte A. Spencer, Michael A. Palladino. 2011. Concepts of Genetics. Pearson Educations.
19. Daniel Hartl. 2011. Genetics Johns and Bartlett Publishers.
20. David Hyde. 2008. Introduction to Genetic principles. McGraw-Hill.
21. Daniel, L. Hart, Elizabeth W. Jones. 2009. Analysis of genes and genomes. John and Barlett.
Journals / Periodicals:
J. Genetics, Theoretical and Applied Genetics, Cytologia, Chromosoma, Genome

Course	Pre-Requisite	Course Title	Credit Hrs
BOT-322	Major-XI	Environmental Biology	03 (2+1)

Specific Objectives of Course:

To provide updated knowledge of environmental problems and sustainable environmental management.

Course Outline:

1. Environment: Introduction, scope, pressure
2. Pollution: definition, classification and impact on habitats

i. Air pollution: Sources and effect of various pollutants (inorganic, organic) on plants, prevention, control, and remediation. Photochemical smog. Smog. Acid rain: 1. Theory of acid rain, 2. Adverse effects of acid rains. Chlorofluorocarbons and its effects.

ii. Water pollution: Major sources of water pollution and its impact on vegetation, prevention, control remediation, eutrophication, thermal pollution.

iii. Sediments pollution: fungicide, pesticides, herbicide, major sources of soil pollution and its impact. Prevention, control remediation. Heavy metal pollution. Tanneries. Hospital waste. Treatments of sewage, sludge, and polluted waters.

iv. Noise pollution.

v. Radiation pollution (including nuclear): Measurement, classification and effects, Principle of radiation protection, waste disposal

3. Forest: importance, deforestation, desertification and conservation
4. Ozone layer: i. Formation ii. Mechanism of depletion iii. Effects of ozone depletion
5. Greenhouse effect and global warming: causes, impacts.
6. Human population explosion: impact on environment.
7. Impact assessment: Industrial urban, civil developments.
8. National conservation strategy: Brief review of major problems of Pakistan and their solutions.

9. Sustainable Environmental management.

10. Wetlands and sanctuaries protection: The pressures, problems and solutions.

11. Range management: Types of rangelands, potential threats, sustainable management.

12. Aerobiology (Pollen allergy & dust allergy).

Lab Outline:

1. Examination of industrial waste water and Municipal sewage and sludge for i. Total dissolved solids. ii. pH and EC. iii. BOD/COD. iv. Chlorides, carbonate, and Nitrates.

2. Examination of water samples forms different sites for the presence and diversity of organisms.

3. Effect of air pollutants on plants.

4. Visits to environmentally compromised sites and evolution of remediation methods

Recommended Books:

1. Newman, E. I. 2001. Applied Ecology. Blackwell Science. UK

2. Mooney, H. A. and Saugier, B. 2000. Terrestrial Global Productivity. Academic Press, UK.

3. Eugene, E. D. and Smith, B. F. 2000. Environmental Science: A study of interrelationships. McGraw-Hill. USA.

4. French, H. 2000. Vanishing Borders: Protecting the Planet in the Age of Globalization. W. W. Norton and Company, NY.

5. Hall, C. A. S. and Perez, C. L. 2000. Quantifying Sustainable Development. Academic Press, UK.

6. Bazzaz, F. A. 2004. Plants in changing environments: Linking physiological, population, and community ecology. Cambridge Univ. Press.

7. Bush, M.B. 1997. Ecology of a changing planet. Prentice Hall, UK.

8. Marsh, M.W. and Grossa Jr., J.M. 1996 Environmental geography: Science, land use, and earth systems. John Wiley and Sons.

9. Lambers, H., T. L. Pons and F. Stuart. 2008. Plant Physiological Ecology.

10. Mohamamd Ashfaq and Mushtaq A. Saleem. Environmental Pollution and Agriculture.

11. Shah Faisal Muhamamd and Sultan Mehmood. 2012. Lambert Publishers Germany.

12. Advanced Air and Noise Pollution Control, L. K. Wang, N. C. Pereira and Y. T. Hung, Humana Press, 2005.

13. Air Pollution Control Technology Handbook, K. B. Schnelle and C. A. Brown, CRC Press, 2002. Handbook of Solid Waste Management and Waste Minimization Technologies, N. P. Cheremisinoff, Butterworth-Heinemann, 2003.

14. Pollution Control In Process Industries, S. P. Mahajan, Tata McGraw-Hill, 1985.

15. Industrial Pollution control: issues and techniques, N. J. Sell, Van Nostrand Reinhold, 1992.

16. Environmental Biotechnology: Basic Concepts and Applications, I. S. Thakur, I.K. International Publishing House Pvt. Limited, 2006.

17. Vandermeer, John H. 2011. The ecology of agro-ecosystems - Jones and Bartlett Publishers; Sudbury, Mass; 2011 - xv, 387 p.

18. Greipsson, Sigurdur. 2011. Restoration ecology - Jones and Bartlett Publishers ; Sudbury, MA ; 2011 - xvi, 408 p

19. Santra, S. C. 2010. Fundamentals of ecology and environmental biology - New Central Book Agency; London; 2010 - 353p.

20. Singh, M.P. 2007 Forest environment and biodiversity Daya; New Delhi; 2007 - 556p. Journals/Periodicals: Environmental Biology, Environment, Bioremediation

Course	Pre-Requisite	Course Title	Credit Hrs
BOT-324		Elective-iii/Research Project / Internship/Optional paper Optional paper: Wetland ecology	03 (2+1)

Objectives: To familiarize the students with the concept of Wetland Ecology, its importance and its role in Biodiversity and Conservation.

Course Outlines

1. Introduction to Wetlands (Wetland definition, types, classification, Origin and distribution of wetlands, Wetlands as elements of the landscape).
2. Wetland Environment (Abiotic factors, Hydrology and Edaphic factors).
3. Aquatic flora and fauna
4. Wetland Values (Wetlands as habitats and Economic importance of wetlands).
5. Attitude towards Wetlands (Human impact on wetlands, Agricultural impacts, Urbanization and Industrialization and Pollution).
6. Wetland Management (History of Wetland management, Wetlands for waste management, Control of exotic species and Man-made wetlands).
7. Succession in Wetlands
8. Role of Wetlands in Biodiversity Conservation

Lab Outlines

1. Survey of Wetlands (Fresh water marshes, Salt marshes, Swamps, Riparian wetlands and Mangrove Wetlands)
2. Collection, preservation and identification of local aquatic flora
3. Morphological and Anatomical studies of various aquatic plants
4. Phytosociological studies of Aquatic plant communities
5. To carried out practical studied on the role of riparian vegetation in soil conservation

Recommended Books:

1. Barbour, M. G., Burke, J. H. and Pitts, W. D. 2004. Terrestrial Plant Ecology. The Benjamin, Cumming Publishing C. Palo Alto, California, USA.
2. Bazzaz, F. A. 2004. Plants in Changing Environments: Linking Physiological, Population and Community Ecology, Cambridge University Press.
3. Chapin *et al.*, 2002. Principle of Terrestrial Plant Ecology, Springer-Verlag.
4. Gurevitch. J. Scheiner, S. M. and Fox, G. A. 2006. The Ecology of Plants\.Sinaur Asssoicate Inc.
5. Hussain, S. S. 1989. Pakistan Manual of Plant Ecology. National Book Foundation Islamabad.
6. Lambers *et al.*, 2002. Plant Physiological and Ecology, Springer-Verlag.
7. Lambers, H., Pons, T. L. and Stuart, F. 2008. Plant Phyiological Ecology.
8. Larcher, W. 2003. Physiological Plant Ecology: Ecophysiology and Stress Physiology of Function Groups. Springer-Verlag.
9. More, P. D. and Chapman, S. B. 1986. Methods in Plant Ecology, Blackwell Scientific Publication Oxford.
10. Nobel, P. S. 1999. Physico-chemical and Environmental Plant Physiology., Academic Press.
11. Schultz, J. C. 2005. Plant Ecology, Springer-Verlag.
12. Smith, R. L. 1998. Elements of Ecology. Harper & Row Publishing.
13. Smith, R. L. 2004. Ecology and field Biology. Addision Wesley Longman, Inc., New York.
14. Townsend, C. R., Begon, M. and Harper, J. L. 2002. Essentials of ecology. Blackwell Publishing.

Course Code	Pre-Requisite	Course Title	Credit Hrs
BOT-325		ELECTIVE-IV (Forestry and Agroecology)	03 (2+1)

Objective: To disseminate forest community, their relationship with local climate and soil and their possible management.

Course Outline

Forest Management: tropical rain forest biome, tropical seasonal forest biome, terrestrial rain forest biome, terrestrial seasonal forest biome, Landscape, Mapping, Restoration and Management, Disaster management: forest fire, flooding, desertification, landsliding, earthquake, drought, pressure, volcanic eruption. Succession , Plant demography; Niche.

Community Ecology: Historical development of community ecology; Qualitative, quantitative, synthetic and physiognomic attributes of communities; Sampling of vegetation: Detailed study; Types of classification and Bray and Curtis ordination of community; Natural biotic disasters and plant communities; Dendrochronology and its application in forest dynamics. Seed biology; World vegetation.

Agroecology : Ecological concepts of ecosystem, Compartmentalization and system concepts, Bioenergy dynamics; Ecological pyramids; Food chain and food web; Eutrophication; Poisonous in food chain; Energy and efficiency flow in ecosystem; Ecological energetic and production ecology. Allelopathy and its effects on plants. Crop rotation, recycling crop, crop waste management.

Lab Outline

Measurements of light, temperature, humidity and wind velocity under different ecological conditions; Effect of light, temperature, moisture and salinity on germination and growth of plants. Determination of seed bank in various populations; Seed dispersal pattern of local populations; Demography and life history of annual population; Competition and allelopathy; Sampling of vegetation by different methods and calculation of community characteristics; Species area curve methods; Community maturity index; Homogeneity test; Field trips.

Recommended Books

1. Ahmed, M. M. 2009. An introduction to dendrochronology. Urdu University press.
2. Baskin, C.C. and Baskin, J.M. 2000. Seeds: Ecology, Biogeography, and Evolution of Dormancy and Germination. Academic Press, San Diego.
3. Barbour, M.G., Burke, J.H. and Pitts, W.D. 2004. Terrestrial Plant Ecology. The Benjamin, Cumming Publishing Co. Palo Alto, California, USA.
4. Chapan, J.L. and Chapman, R. 2006. Ecology: Principles and Applications. Cambridge University Press.
5. Fenner, M. 2007. The Ecology of Seeds. Cambridge University Press.
6. Grime, J.P. 1995. Plant Strategies and Vegetation Process. John Wiley and Sons.
7. Harper, J.L. 1977. Plant Population Biology. The Prentice Hall.
8. Hussain, S.S. 1994. Pakistan Manual of Plant Ecology. National Book Foundation of Pakistan.
9. Khan, M.A. and Weber, D.J. 2006. Ecophysiology of High Salinity Tolerant Plants. Springer, Netherlands.
10. Kozlowski, T.T. 2006. Growth Control in Woody Plants (Physiological Ecology). Springer.
11. Krebs, C.J. 1981. Ecology. Harper and Row Publishers. NY.
12. Larcher, W. 2003. Physiological Plant Ecology: Ecophysiology and Stress Physiology of Function Groups. Springer-Verlag.
13. Michael, J.2005. Climate change and managed ecosystem.CRC publishers.
14. Morin, P.J. 1999. Community Ecology. Blackwell Publishing.
15. Newman, E.I. 1999. The Plant Community as a Working Mechanism. Blackwell Scientific Publications.
16. Putman, R.J. 1994. Community Ecology. Springer.
17. Ricklefs, R.E. 2005. Ecology. W.H. Freeman and Company, UK.
18. Roger, M.J.R. 2005. Handbook of Plant Ecophysiology Techniques. Springer.
19. Ribaut, J.M. 2006. Drought Adaptation in Cereals. Hawthorn Press.

7. Schultze, Ernst-Detlef and Mooney, H.A. 1994. Biodiversity and Ecosystem Function. Springer